INDUSTRIAL ENGINEERING
PLANT ENGINEERING IN INDUSTRY
A McGraw-Hill Publication—Established 1882

Volume 87 CHICAGO, OCTOBER, 1929 *Number 10*

The Philosophy of Modernization

. . . Modernizing—or modernization—or bringing oneself and his belongings up-to-date is a hard thing for some people to understand. Their attitude is: We're getting along well enough—we don't need anything new—what's the matter with what we have? These people deserve sympathy, and they also need to be enlightened.

. . . There is one result of acquiring the very latest something-or-other that almost every one has experienced. The longer he has it the more difficult it is for him to understand how he ever got along without it.

. . . What a difference the coaster brake made to the bicycle riders. . . . The self-starter and storage battery to motorists. . . . High-speed steel in the machine shop. . . . Exhaust systems in woodworking plants. . . . Automatic feeders in the printing industry. . . . Aluminum alloys to aviation. . . .

. . . And how did individuals and industries ever get along without them? How did they get along without the countless other inventions and developments that today make the effective lifetime many times greater than it was fifty years ago?

. . . There's the modernization philosophy in a nutshell — people and industries simply can't get along with out-of-date, inefficient, time-consuming stuff. On top of that, they have to realize that every day everything is tending toward becoming obsolete, because this world isn't standing still.

. . . But such a philosophy implies constant change. Where to get the money to pay for all the changes? Well, really the answer is, "They pay for themselves." That production equipment does has been shown in publications in the production field; that auxiliary equipment does has been shown in many articles in *Industrial Engineering*.

. . . Moreover, it is obvious that no plant can hope to obtain the full benefit from even the most efficient and modern production equipment unless the auxiliary equipment and services upon which production depends are geared up to the same standard of modern design and efficiency.

. . . For that matter, everything is relative. The mortality of one kind of equipment, limited by obsolescence, may be six months, of another a year, of still another ten years. The job of keeping modern isn't so difficult or so costly as it seems—it's really gradual change—but it must be constant.

489

Modern Drives and Mate

mean low power consumption

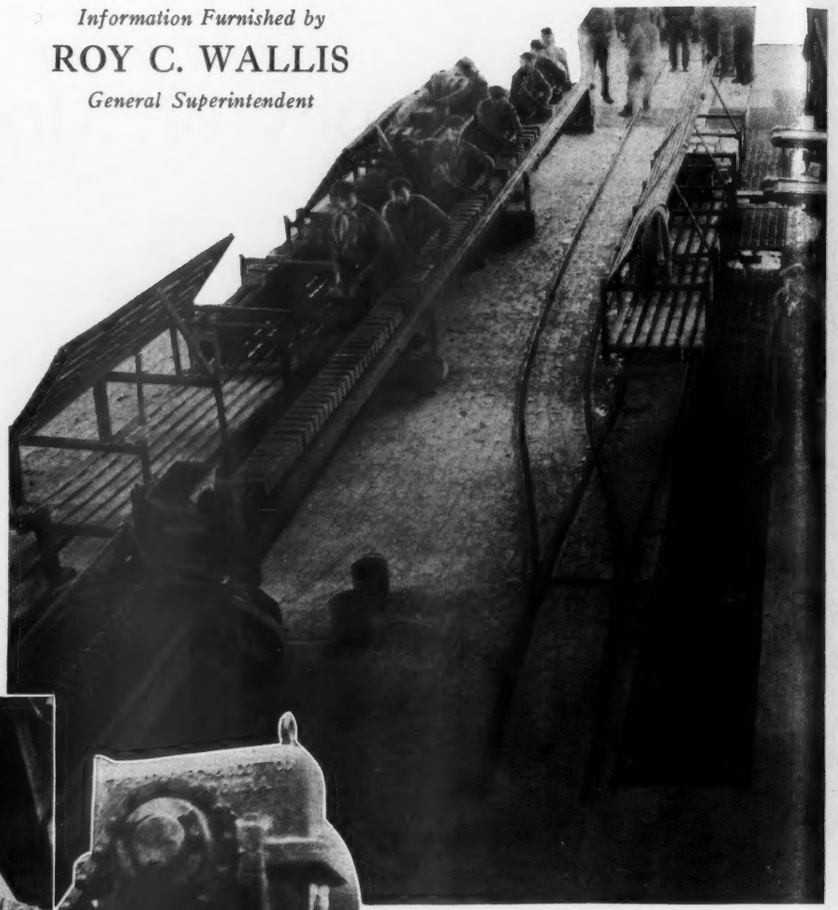
Information Furnished by
ROY C. WALLIS
General Superintendent

POSITIVE and economical transmission of power is an essential in the manufacture of brick. To show how this essential is provided by the modern power transmission equipment in the Bessemer, Pa., plant of the Metropolitan Paving Brick Company is the object of this article.

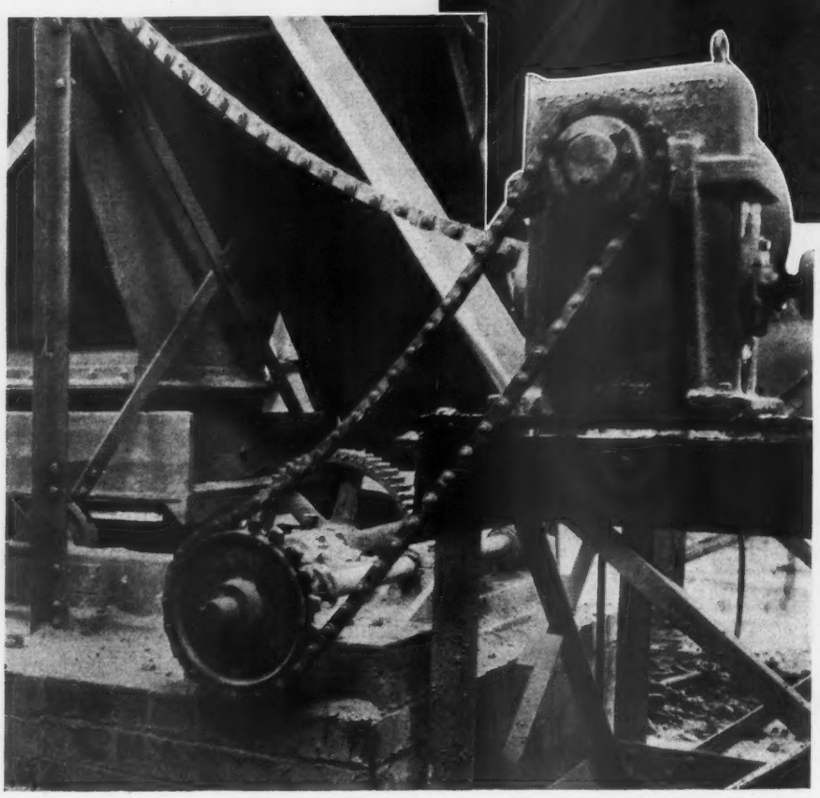
Unless the burden of heavy labor is placed on machinery, instead of man, the equipment is not modern. In the design of this plant, therefore, and in the selection of equipment, the product is handled wherever possible by machinery.

Our bricks are made from shale taken from a deposit located a half-mile from the plant. It is transported

* * * *



An example of combined drive. One motor drives the conveyor delivering material from the storage bin to the dry-pan hopper and the reciprocating feeder that delivers it from the hopper to the pan.



Cutting machines, carry-off belts, represses, and waste conveyor system. Represses are driven from a line shaft, and when not in use are run back on short tracks. The gratings cover the waste conveyor belts,

* * * *

in steel air-dump cars over standard gage tracks and dumped on a steel apron conveyor (1)* which carries it to a hopper, whence it enters a motor-driven roll crusher (2).

From the crusher the clay is carried by conveyor (3) to a bin over a pair of corrugated roll crushers (4) from which it drops to a conveyor belt (5) extending the length of a 20,000-ton storage shed. It can be discharged at any point.

*Figures in parentheses refer to same figures in list of "Drive and Other Details."

rials-Handling Equipment

in this paving-brick plant

which carry the waste to an elevator shown just back of the left-hand line of represses. Cars of brick are hauled to the dryers on an electric transfer, tracks for which are located at the end of the room shown.

* * * *

Below the storage shed are two tunnels, each containing a conveyor belt (6) leading to an inclined conveyor (7) over feeders. Through openings in the bottom of the shed, and by means of a traveling hopper, the clay can be dropped to the conveyor belt at any point.

Each of the inclined conveyors is equipped with a magnetic drum and delivers clay to a feeder, or hopper, from which it enters a dry pan (8). These two conveyors are the beginning of twin process lines.

From the pans the ground clay is delivered to a bucket elevator to be carried to a drag conveyor (9). This conveyor carries the material from the elevator to the screens (10).

Fine clay from the screens drops to a transfer belt conveyor (11) and by it is carried to another belt conveyor (11) and thence to the pug mill room. Coarse clay from the screens passes to chutes that return it to the pans where it is reground.

Bins receive the material to be pugged, and from them it is fed by off-set disk feeders (12) to the pug mills (13).

From the mills the clay is delivered directly to the brick machines (14) by means of a chute. As the brick column is extruded from the brick machine it is cut into bricks by reciprocating cutters (15) and the bricks are carried off by belts (15).

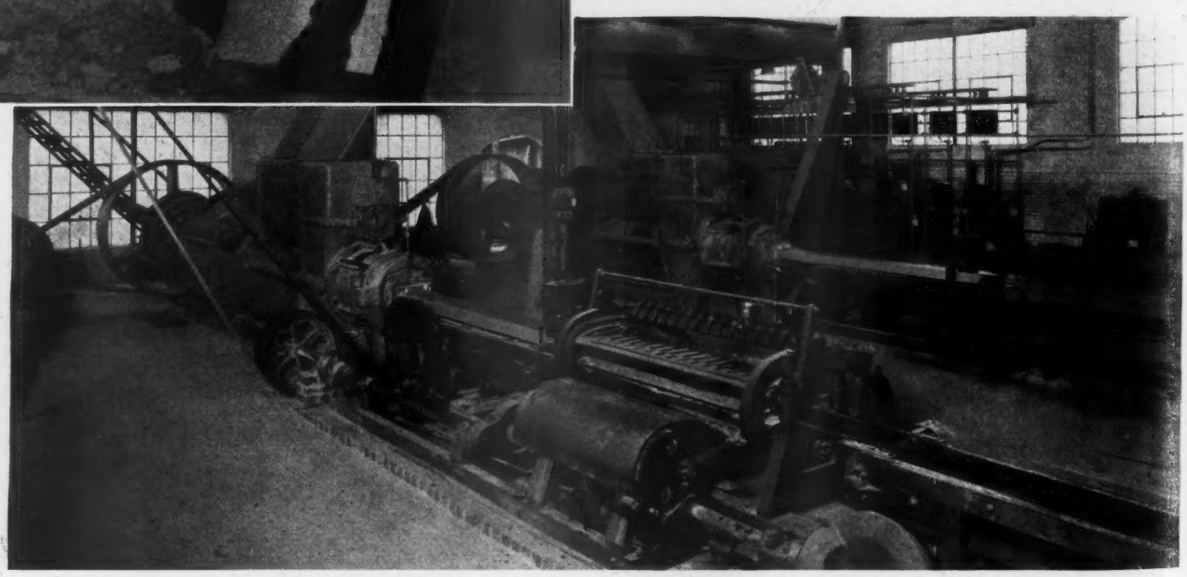
* * * *

Roller thrust bearing on one of the combined brick machines. The friction clutch and part of multiple V-belt drive are shown.

Magnetic pulley and pile of tramp iron.

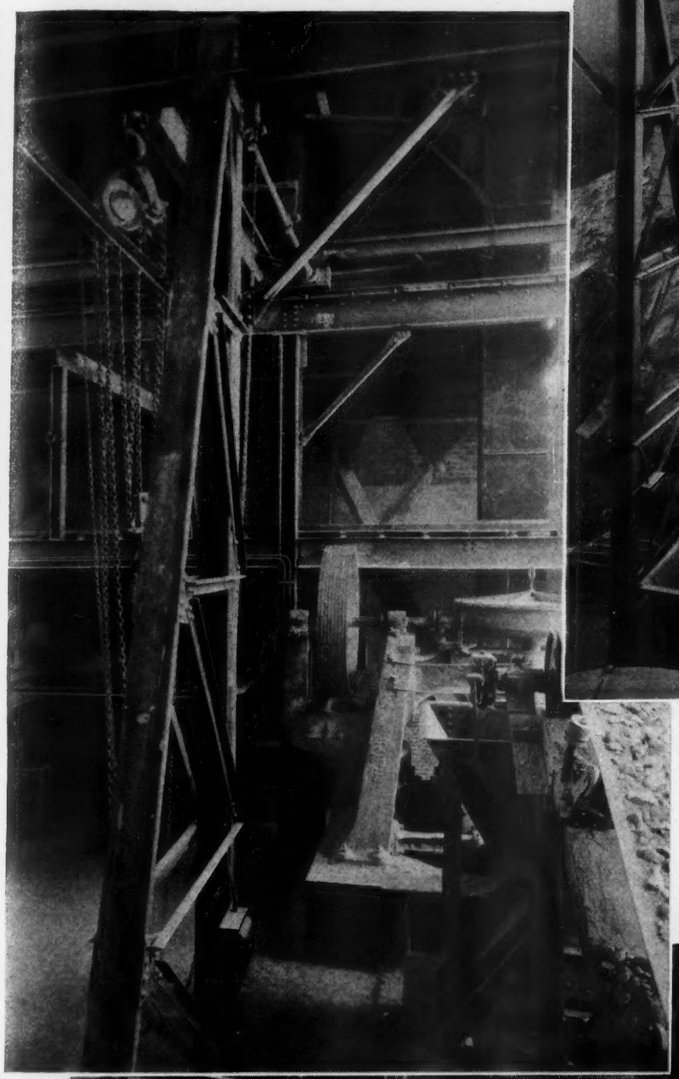
Close view of multiple V-belt drive for pug mill, and bevel gear drive for the disk feeders on the bins.

Roller bearing on pug shaft of pug mill. Also start of chute that delivers pugged clay directly to combined brick machines on floor beneath.



The two brick machines. The pug mills are located in the room directly over them, delivery of the material being by means of the steel chutes shown. Bracket-mounted motors and geared speed reducers drive the cutting machines and off-carrying belts. Synchronous motors, multiple V-belts and friction clutches are involved in the brick-machine drives. In the background is the switching equipment which distributes power for the entire installation.

General view of one of the dry pans, elevator, and screens.



General view of the crushed shale storage bins, showing the tunnel and the conveyor that delivers material to the dry pans. The conveyor from the crushers is just under the roof, being supported by the piers that divide the bins. The combined drive of the tunnel conveyor and hopper feed and the magnetic drum are shown.

Belt conveyor that receives material from the screens. Oversize is returned to the dry pans by the chutes shown to the left.

Drive and Other Details

(1) Steel apron conveyor, 5x40 ft., driven by 25-hp. motor.

(2) Roll crusher, 24x60-in., 150-hp. slip-ring induction motor.

(3) Conveyor belt 40 in. wide, 240 ft. long, 8-ply canvas.

(4) Corrugated roll crushers, driven by slip-ring motors.

(5) Conveyor belt 30 in. wide, 730 ft. long, 5-ply, $\frac{1}{16}$-in. rubber covered; concentrator roller-bearing troughing, driven by 25-hp., slip-ring induction motor, controlled by distributor and automatic trip.

(6) Conveyor belt, 540 ft. long. A magnetic pulley at delivery end abstracts tramp iron.

(7) Conveyor, driven through speed reducers by 20-hp., squirrel-cage induction motors.

(8) Dry pans individually driven by 60-hp., slip-ring, induction motor, through multiple V-belt drives. Pans are equipped with roller thrust step bearings and roller radial bearings.

(9) Drag conveyor, driven by the same 15-hp. induction motor that drives the elevators.

(10) Magnetic vibrator screens, power supplied by 4-kw., low-frequency synchronous motor-generator.

(11) Belt conveyors, driven through chains by a 10-hp. squirrel-cage induction motor.

(12) Off-set disk feeders (three) driven from common shaft by 15-hp. squirrel-cage induction motor.

(13) Pug mills, completely equipped with roller bearings and individually driven through multiple V-belt drive by 40-hp. synchronous motors and speed reducers.

(14) Brick machines, capacity 10,000 10-lb. paving brick per hour each, driven individually by 125-hp. synchronous motors through multiple V-belt drives and friction clutches. Machines are fully equipped with roller bearings.

(15) Reciprocating cutters and off-bearing belts driven through speed reducers by 5-hp., squirrel-cage induction motors.

(16) Repressing machines, driven through canvas stitched belt and friction clutches from line shaft by means of a 20-hp. squirrel-cage induction motor.

(17) Main waste conveyor and waste elevator are driven by a 10-hp. squirrel-cage induction motor through speed reducers and roller chains.

Repressing machines (16) are necessary in making pressed brick. Six are available. All are on roller skids, and are moved into and out of position on tracks. They are placed in the production line as needed.

A system of belt conveyors (17), elevators (17), and chutes returns all waste material from the machine room to the dry pans or the pug mills as required. This system is practically automatic, most of the waste falling to the conveyors through gratings in the floor.

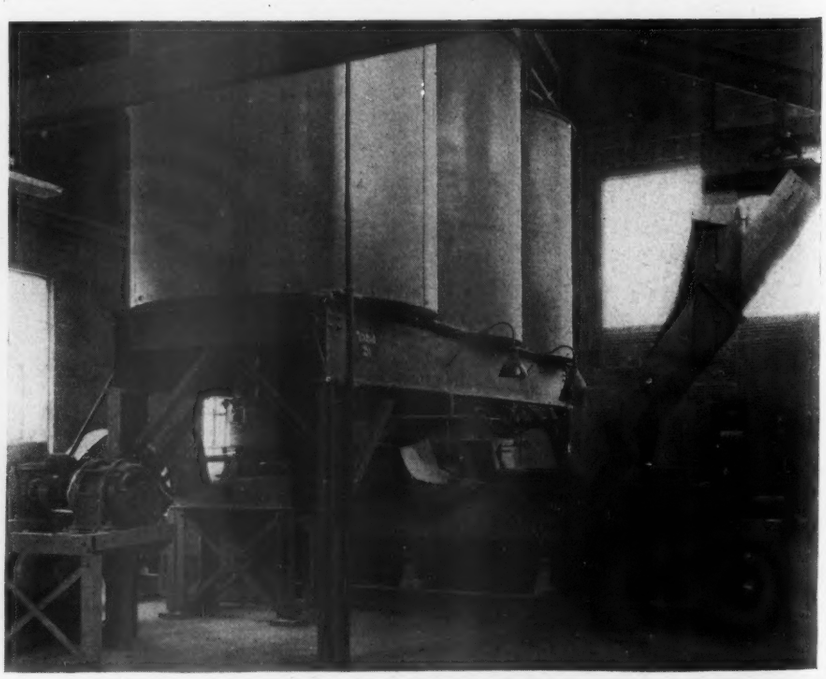
To give the dollars and cents saving on account of modern equipment is impossible, because the new plant has not been in operation long enough. However, though the new plant has a greater capacity than the old, the connected load is 350 kw. less, and the daily demand is around 200 kw.-hr. less. The power factor is kept at 0.96, chiefly due to the use of synchronous motors to drive the heavier machines.

Roller bearings are responsible for much of the lower power consumption. All of the heavier machines (dry pans, pug mills, and brick machines), and most of the conveyors and gear drives are so equipped. Single motors frequently are called upon to drive two or more devices not under heavy-duty requirements.

The speed-reducer equipment, because of its modern design, also helps to keep down power losses. The reducers are inclosed units, with moving parts kept in oil baths, and without exposure to abrasive dust, which is plentiful in a brick factory.

The plant has a daily capacity of 150,000 10-lb. paving block or 275,000 standard size building brick.

* * * *

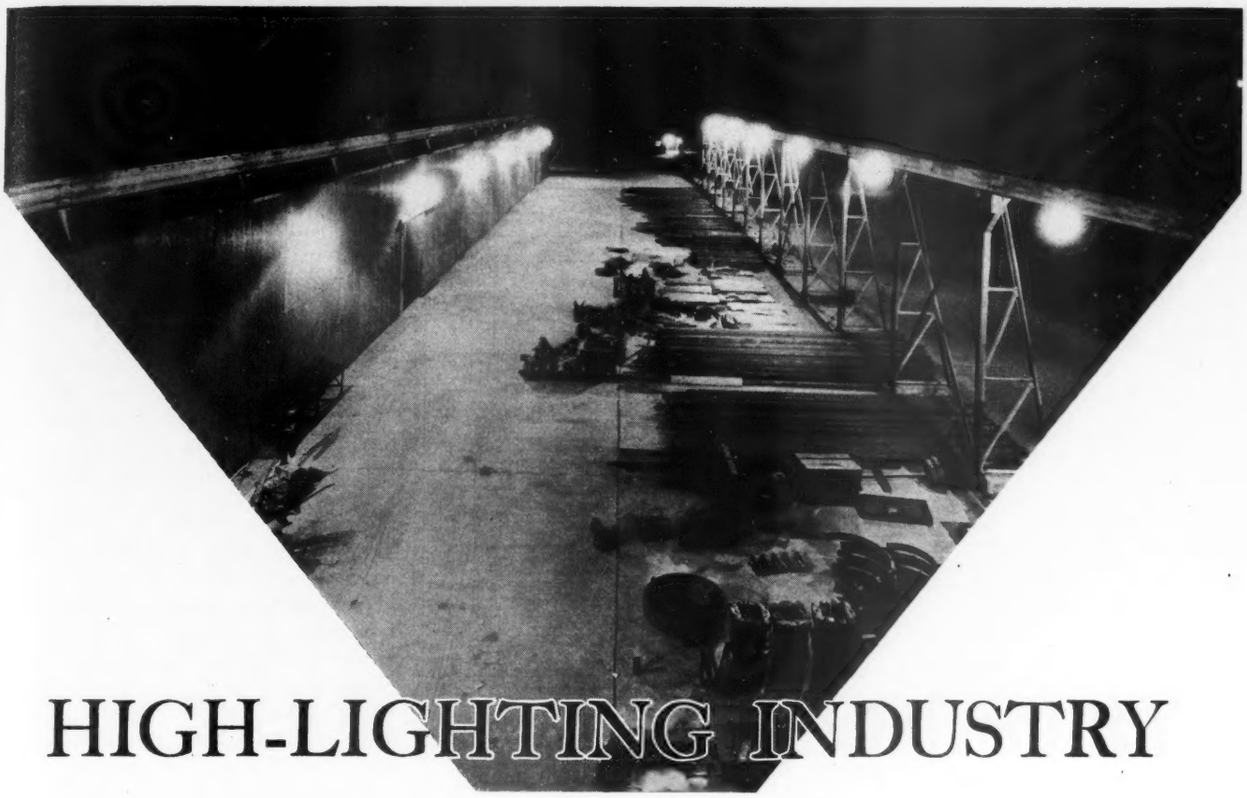


Storage bins and pug mills. The waste return chute is shown to the right. At the left is the motor driving the disk-type feeders that feed the clay to the pug mills.

Clutch Speed and Power

Clutches are nominally rated at 100 r.p.m., but it must be remembered that a friction clutch will not transmit power in direct proportion to its speed. For example a clutch that will transmit 10 hp at 100 r.p.m. will transmit only 30.8 hp. at 400 r.p.m. Hence, the final step in selecting the size of clutch required is to apply the correction factors for speed and character of service that are given in the tables which can be obtained from any manufacturer.

WILLIAM STANIAR.



HIGH-LIGHTING INDUSTRY

with 54.3 foot-candle intensity

No plant is really modern without *planned lighting* designed for its particular repuirements

By FRANK A. HANSEN

Engineer
Holophane Company, Inc.
Los Angeles, Calif.

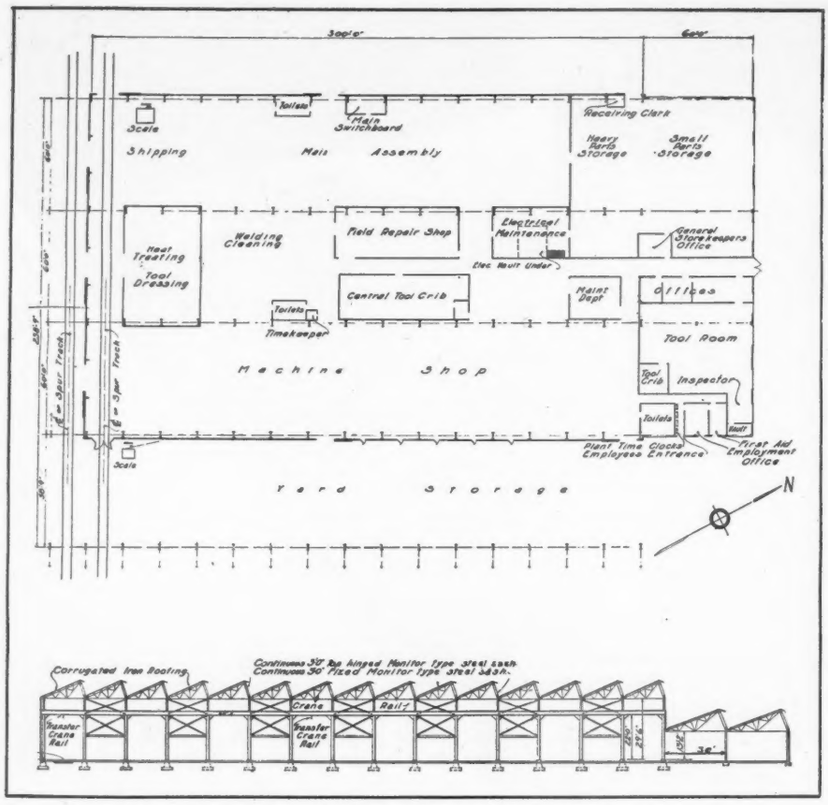
PLANNED industrial lighting in which the amounts of light to be obtained were predetermined and guaranteed and in which, probably, the highest intensities in an industrial plant are involved, are some of the features of the recently completed plant of the Doheny-Stone Drill Company, Torrence, Calif. A study of the plan and section of the building as shown in accompanying illustrations indicates the problems that confronted the illuminating engineer in laying out the installation.

In the general floor plan of the main shop building will be seen the various areas outlined for particular production or shop activities whereas the longitudinal section of the same building emphasizes the conditions of installation, indicating ceiling heights, class of construction, and so on. By referring to this illustrations it is realized that it was necessary to classify the building into different areas with respect to the requirements of illumination.

Naturally, the job divided itself into three parts: the lighting of the high-ceiling areas; the lighting of the low-ceiling areas; and the illumination of the storage yard and plant exterior. Divided as such, special consideration was given to provide higher intensities for machine operation, and lower intensities for other areas (amount depending upon use) in the case of the high-ceiling areas under which was included the watchman's circuit. Similarly, in the low-ceiling areas there were the tool room for which exceptionally fine lighting was desired, offices (shop, drafting, clerical, and miscellaneous), storage areas, tool crib, etc., and entrances. Then for the yard storage and exterior lighting generally, active storage areas, inactive yard space, roadways and traffic requirements and watchman's circuit, other values had to be considered. Usually the light requirement of each area depends on the nature of the work to be performed there; the type and operating characteristics if there are machines; and, at all times the shadowless illumination of any surface it is desirable to see.

From the tentative plans of future expansion this building is to be the first of four and at some future date it will be used entirely as a machine shop. Thus the original lighting plans would have to be elastic so that future machinery installation would not necessitate additional lighting equipment.

In the high-ceiling area of the main shop it was planned to use a lighting unit, which had been designed for such heights and coverage and then properly lamp these units to obtain the required light intensity, that is, by increasing the lamp size. At the time of installation it was decided to



General floor plan and longitudinal section of the main shop building with various areas outlined for shop activities.

use 300- and 500-watt lamps in the assembly and storage areas and 750-watt lamps in the more brightly lighted machine shop section. The wiring for all equipment in this part of the plant was installed to care for 1,500 watts per unit, which was calculated to be adequate for probable future lighting requirements. The first lamp renewal in the machine shop area replaced the 750-watt lamps with 1,000-watt units, thus substantiating the conclusions about future changes. This change was made during the first six months of operation.

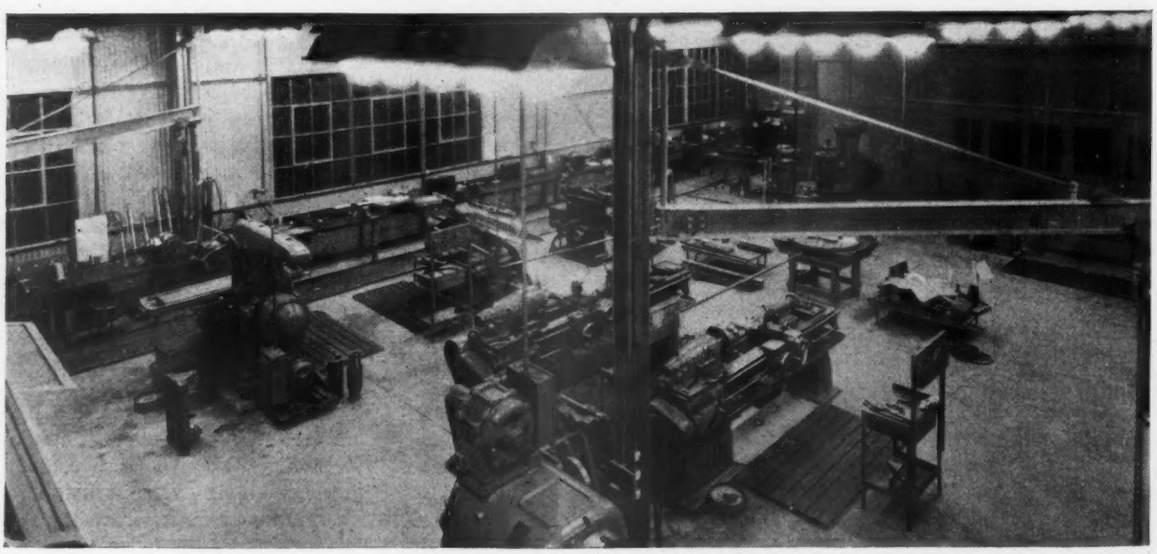
After being supplied with data covering the light reflecting characteristics of paint of various colors and descriptions, aluminum paint was sprayed on the interior structure, which formed an efficient light reflecting surface that blended well with the galvanized iron in the roof and sides of the building. Following the same idea of light reflection, the machinery was finished in the same shade of a good utility gray.

High Ceiling Interior

As previously mentioned, it was decided to provide the high-bay area of the plant with general illumination, the intensity of which could be raised by increasing the lamp size at desired points. The required initial intensity for the machine shop bay was specified by the engineering department at 15 foot-candles. For other sections of the shop the specified intensity was 10 foot-candles.

It was desirable to flood the room with light so that the working surfaces of the machines would be illuminated and, in addition, the space through which the crane hook's load traveled. It was also desirable from the viewpoint of efficiency to use the largest size of lamp that would be practical since large lamps would produce more light and be cheaper to install than smaller lamps of the equivalent wattage.

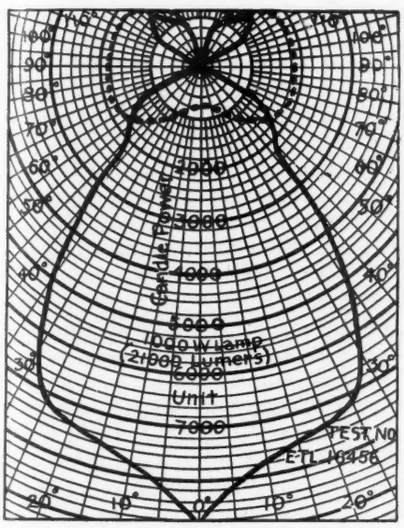
After the higher-wattage lamp had been selected, it was advisable to locate the light sources at remote positions with reference to the working surfaces. Large cranes would be traveling continuously overhead, making it necessary that the lighting equipment be out of the way. It was also advantageous to position the units so that as nearly as possible any glare from them would not be reflected back into the workman's eyes from the material being machined. The consideration of these requirements, in addition to the structural characteristics of the building, auto-



Night view of toolroom showing uniformity of lighting. The average illumination with all units lighted is 42 foot-candles.

matically determined the mounting height as being above the crane.

The building is designed with three 60-ft. craneways running lengthwise. From the grouping of machines and work, each of these 60-ft. areas was considered as a separate room. Midway in this craneway were located two structural chords on 20-ft. centers, and upon which it was decided to suspend the lighting equipment. In selecting this position, economy of electrical installation was also a determining factor, since another mounting location would have caused the electrician considerable trouble from two angles: (*a*) difficulty in following the trussed structure, (*b*) long stretches of conduit requiring scaffolding and the use of long supporting hangers.

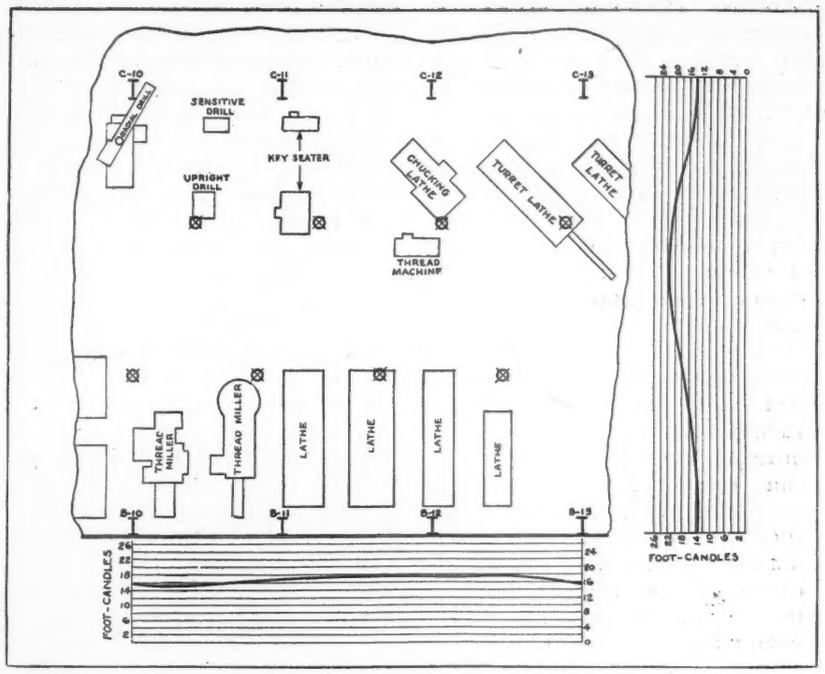


Characteristic light distribution curve of high-bay unit.

* * * *

Since the crane travels under these light sources, the next step in design was to stagger the unit with relation to its mate across the craneway. In this manner the crane shadows were virtually eliminated as it was possible for the crane to screen only one light source at a time, the overlapping light from the other units covering the areas below in the meantime.

As the clearance between crane and structure was not sufficient to support the unit below the chord, it became necessary to suspend the unit and conduit as shown in another view. (The conduit bracket illustrated was designed by W. H. Skivington, electrical engineer of the Doheny-Stone Drill Company.) A study of this photograph indicates the following major advantages of such a means of support: (*a*) The conduit may be very securely installed in a straight continuous run even in complicated structures; (*b*) This type of construction saves much labor and material. (This system cost approximately 40 per cent of the estimated labor and material cost of making the installation by following the structure with conduit.)



Actual average foot-candle intensities in typical section of high-bay machine shop. Readings were made on 10-ft. centers.

Other illustrations show the high-bay lighting unit selected for this part of the building, and the distribution curve for the unit. The selection of the unit was based principally on its distribution characteristics, its lamping flexibility, as well as initial and continual efficiency. Ease of maintenance was also a factor.

Thirty-five units were planned for each 60x300-ft. bay, each unit serving 514 sq.ft. of area. The staggered spacing on the long dimension of the bay was 16 ft. 6 in. The units were spaced through the width of the bay on the center chords 20 ft. apart.

After these outlets were located on the plan, the following formula was used to determine the lamp size:

$$\text{(A) Lamp lumens required per square foot} = \frac{\text{Foot-Candles}}{\text{Coefficient of utilization} \times \text{Probable average illumination in per cent of initial illumination}}$$

(Note: "Coefficient of utilization" is the ratio of light delivered to the total light of lamps. Room size, reflection of ceiling and walls, mounting heights, efficiency of unit are some of the determining factors.)

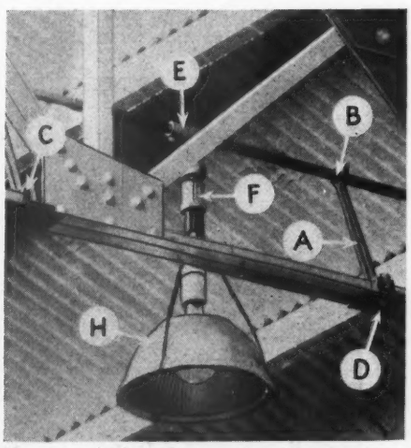
Substituting the known values, the equation becomes

$$\frac{15}{0.68 \times 0.80} \text{ or } 27.6 \text{ lamp lumens per sq.ft.}$$

(B) Lamp lumens per outlet = Area in sq. ft. per outlet × Lamp lumens per sq, ft.

or 544 sq.ft. × 27.6 lumens = 14,186 lumens per lamp.

It is found that a 750-watt lamp produces 14,800 lumens; thus its use, according to the foregoing formula.



Method of hanging conduit with Skivington brackets. (*A*) Cast-iron bracket hanger. (*B*) Conduit held in fork with cotter pin. (*C*) Bolt through hanger holding bracket against structural member. (*D*) Nut holding ¼-in. plate against bottom of chord and bracing bracket above. (*E*) ¾-in. tee. (*F*) Shock absorbing hanger. (*H*) Adjustable unit.

Another illustration shows the average intensities through a typical shop section. These averages were obtained by making 49 readings on 10-ft. centers in the area shown.

Readings made four months after the first tests indicated a total net light loss of 8.3 per cent. It was estimated that the lamps had been burning some 800 hours at this time, there being other additional losses due to accumulations of dust on side walls, lamps, and so on.

The irregularities in foot-candle curves shown were later corrected when 1,000-watt bowl-frost lamps (adding about six foot candles to this intensity were installed in the machine bay. The bowl frost lamp tended to widen the distribution curve, and to add some additional diffusion to the light. A slight tilting of the units away from the center of the shop corrected the uniformity of intensity across the width of the bay.

A night view is included of the main machine shop taken before all machine tools were in place. There is also a "closeup" of material in a lathe as the operator sees it. Close examination shows six soft highlights on this material indicating that there are six remote light sources contributing to the uniformity of the illumination. The lighting effect is quite similar to that of daylight.

Low Ceiling Interior

The saw teeth of the roof in the front low part of the building are 30 ft. apart, being otherwise of a design similar to that part of the building just discussed. Reference to the plan view will indicate the lighting requirements here, the most important area being that of the tool room.

Checking the possible mounting height it was found that the clearance between floor and lower chord is 13 ft. 2 in. The north side wall is virtually all occupied by window sash as are the 7-ft. faces of the saw teeth in the ceiling. This steel sash is glazed with ¼-in. rough wire glass so that from the viewpoint of artificial illumination the problem is somewhat difficult. It is evident that any light falling on the glass in the ceiling or side walls would not be reflected back into the room; rather, it would be transmitted out of doors. In the toolroom it was desirable to have a high intensity of shadowless, uniform lighting because the work here is of a fine precision nature, principally the preparation of shop standards, jigs, and so on.

In consideration of the large glass areas in the ceiling and walls and the comparatively low mounting height, plus the necessity of having shadowless uniform lighting, it was decided to employ for this room: (*1*) The largest practical number of light sources. (*2*) These light sources must: (*a*) give maximum diffusion (*b*) have low surface brightness (so workman's attention would not be distracted upwards) and (*c*) provide direct maximum illumination in both horizontal and vertical planes.

Five totally-inclosing prismatic refractor-reflector units were incorporated in a single trough assembly 5 ft. long. Completed assemblies, each weighing 40 lb., were then suspended from structural members with chain at a mounting height of 13 ft. These assemblies were placed on 10-ft. centers with alternate units mounted at right angles, and fitted with 100- and 150-watt lamps. The average intensity provided was 42 foot-candles with a maximum intensity of 54.3 foot-candles in the inspectors' department.

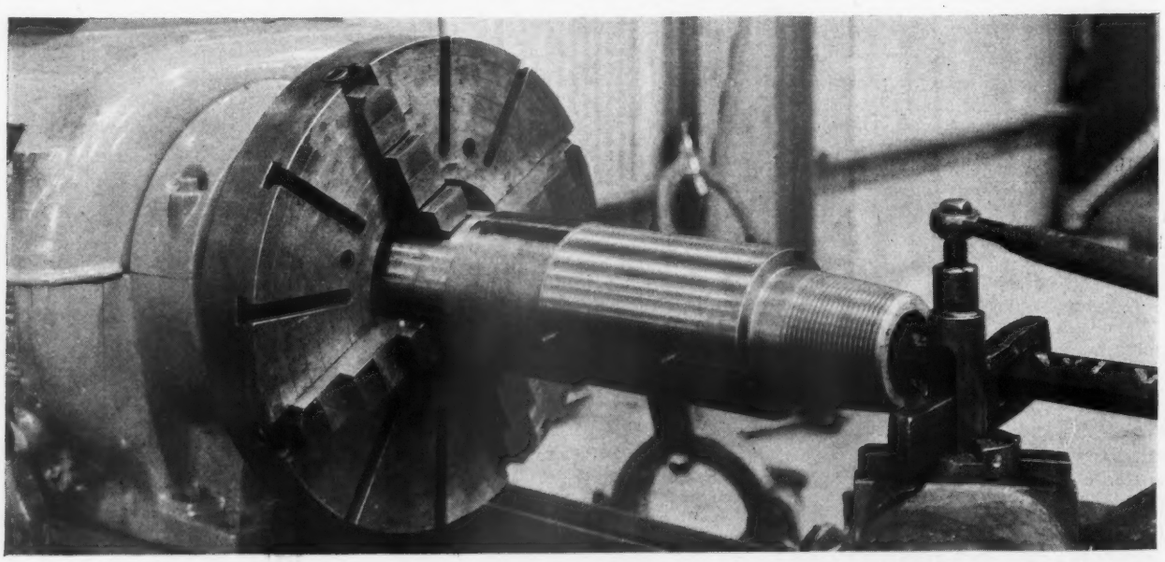
Storage bins were lighted with a newly designed unit using 60-watt lamps on 11-ft. centers. Even illumination was provided on the bin identification cards from top shelf to floor. General illumination of 5 foot-candles was supplied for open floor storage space.

Yard Lighting

In lighting the active material yard the following points received consideration:

1. There were no ceilings or side walls to assist in reflection.
2. The equipment must be waterproof.
3. In addition to reasonably uniform horizontal illumination, it is very important to light all vertical surfaces as all material is identified with painted numbers on vertical sides, and inasmuch as material is constantly being changed around, the lighting result must be maintained.
4. The space between the crane hook and the floor must be lighted for the safety of the workmen.
5. All lighting equipment must clear the crane.

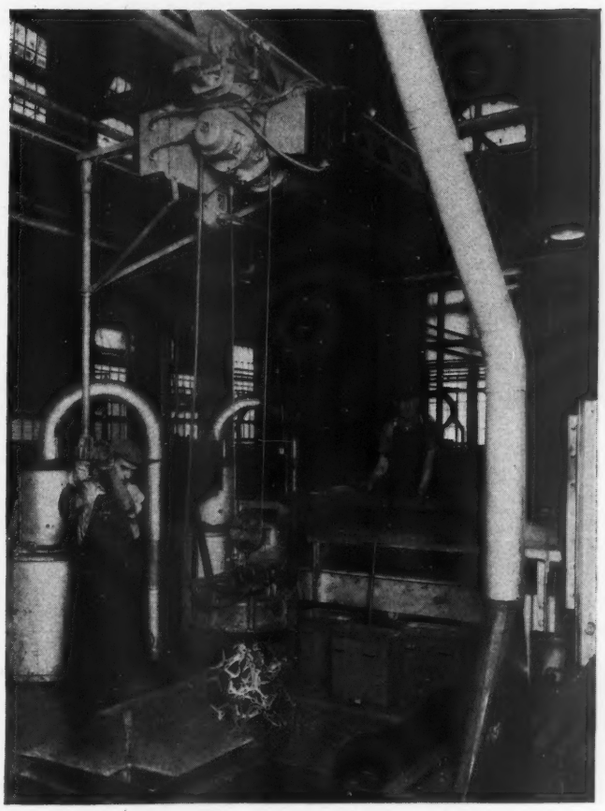
All photographs illustrating this article are unretouched, and the night pictures were all made under the illumination described herein. In an article which will appear in an early issue, details regarding the cost of installation and the cost of operating this system will be discussed.



Close-up of material in a lathe in the high-bay section as the operator sees it.

Mechanical Aids to Systematized Production

How specific applications of modern materials-handling equipment have benefited the National Cash Register Company



A magnet separating steel parts from carburizing material. The residue is carried up the flue to a cyclone hopper which feeds the packing benches.

J. L. COCHRAN
Assistant Efficiency Engineer

MANY examples of specific applications of various types of materials handling equipment that are paying their way are to be found in the plant of the National Cash Register Company, Dayton, Ohio. And only through such installations is it possible to obtain and maintain the orderly and systematized production which is so much in evidence in the manufacture of parts, the assembly of which scores cash over the counter the world over.

Outstanding among the reasons for the intensive use of mechanical aids, that is, materials handling equipment, is the policy established by the management for the elimination of drudgery, human and vehicular. The policy is to the effect that not a thing shall be moved except by a conveyor, where at all possible. The enforcement of this policy is strikingly emphasized in small parts washing equipment which is installed in the basement of one of the departmental buildings devoted to manufacturing processes.

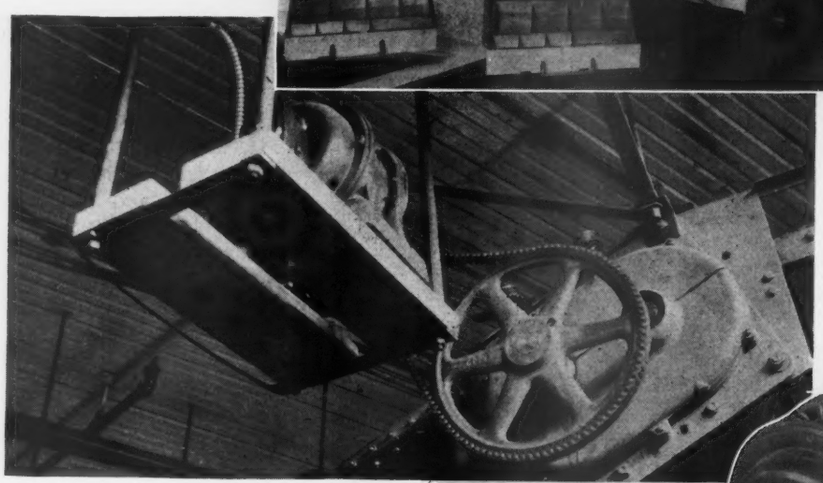
Before the present equipment went into production small parts were handled to and from the washer by means of a conveyor assembly but four men were required to maintain the pace set up by the production department. The small parts were received in boxes from which they were transferred to trays that were sent through the washer. After cleaning, the parts were returned to the original boxes and despatched to the next operation or point of assembly.

Because of gradual deterioration from long periods of continual use the entire washing mechanism had to be replaced, and inasmuch as jobs are not always figured on the basis of just plain savings, the problem resolved itself into figuring the best way to do a good job better. The adoption of new and modern devices just because they are available is not the rule, it is rather the exception, however, when a piece of equipment is to be replaced the resultant advantages of all types are considered carefully before the selection is made. In the modernized installation all trucking was to be eliminated in keeping with the plant policy.

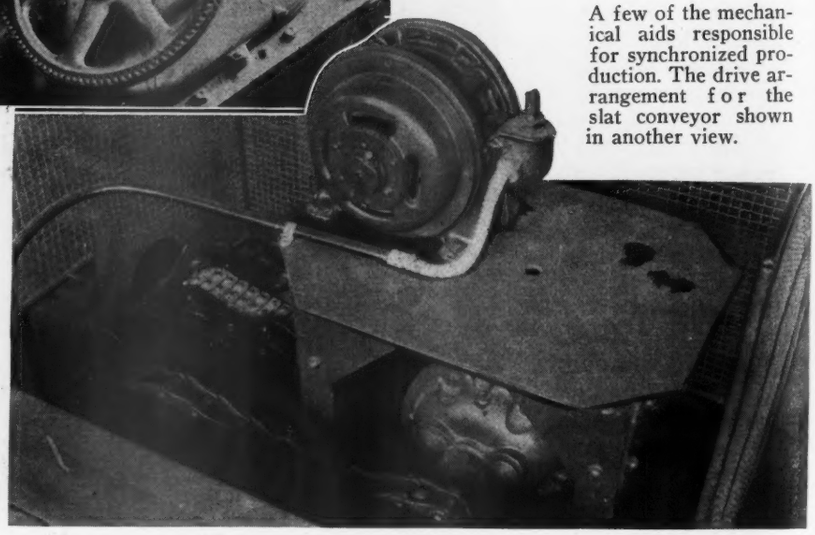
Accordingly, the material to be treated in the washer flows direct from the floors above by means of gravity conveyors and it is despatched after treatment in the identical containers in which it was received. The installation is shown by the various accompanying illustrations. Instead of four men being retained to operate the unit, three only are required, representing a saving in labor expense of 40 per cent over the previous installation, made possible by saving in man power and increased efficiency.

The unit consists of a combined washer and dryer of the gas-fired type, manually controlled. The tem-

Part of the mechanization which reduced the finishing time of cash drawers from 48 hours to 48 minutes. The material is entering the spray booth over the heaters at the left and emerging from the drying tunnel at the right.



One way of solving a difficult drive problem. The motor platform is suspended from the ceiling.



A few of the mechanical aids responsible for synchronized production. The drive arrangement for the slat conveyor shown in another view.

perature of the drying oven is maintained at about 600 deg. F. The washer proper consists of a rotary drum and a conveyor. Parts that will not stand the tumbling action in the rotary drum are transferred from the boxes to baskets which travel through the washer on the conveyor; however, the greater proportion of the material can be put through the drum without damage at an average speed of 200 batches an hour, each batch weighing approximately 40 lb. Figured on the basis of a 9-hr. day, the capacity of the unit is about 36 tons of material thoroughly treated.

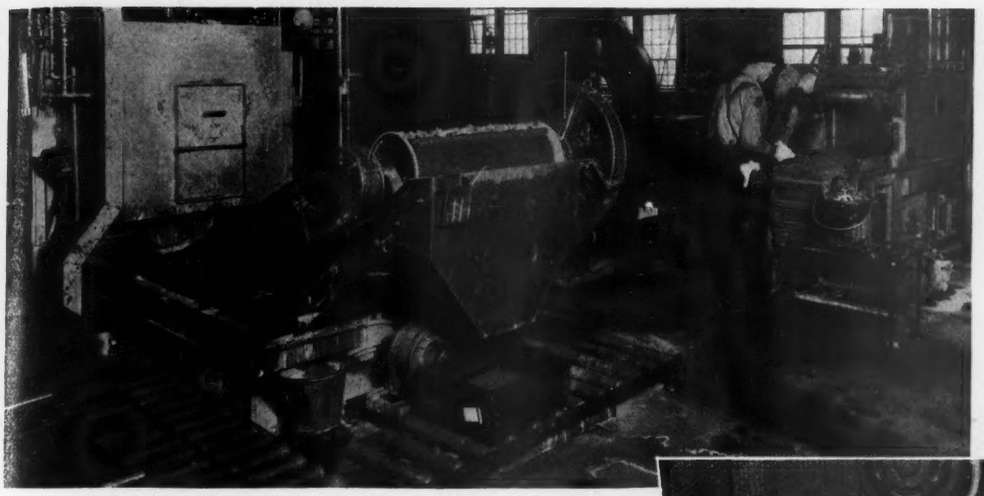
On a test run over a period of 9 hours the total number of boxes put through the unit amounted to 2,126. The maximum and average number per hour were 305 and 236.2 respectively; the maximum and average number per minute were 5 and 3.9 respectively.

The operator, shown in an accompanying illustration, having three lines to draw from, either dumps the material into the rotary drum at the front end of the unit from the boxes or he places the baskets onto the conveyor which takes up the right-hand portion of the unit. A basket prepared for treatment may be seen at the right in this same view.

As the boxes in which the material is received are discharged into the washer, either by dumping direct into the rotary drum or as transferred to baskets, they are despatched to the rear of the unit on the gravity conveyor which may be seen just beneath the inclosed switch boxes that are mounted on the column to the right.

The time of travel through the rotary drum is 40 sec. All details are synchronized in such a manner that the original boxes or containers, to which the order forms for the material are still attached, reach the outlet or drier end as the material is being discharged from the unit. In this manner the material is despatched from the unit in the same container in which it was received without the necessity of any additional handling whatsoever. The operator at the discharge end simply checks the material with the order form clipped to the box and starts it on the way to its proper destination by placing it on the belt conveyor which is shown at the right of the washer.

The details of this conveyor drive may be seen by referring to the illustration. Chain is used as the drive medium between the a.c. motor which is mounted on angle-iron framework and the conveyor drive sprocket.



Steel conveyors are used in elevating the small parts from the hardening furnace quench tank. After hardening, the parts are cleaned in the metal parts washing machine at the right.

Push-button control is used exclusively. All stations are within convenient reach of the operator responsible for particular operations.

Another view shows the drive arrangement of the rotary drum on the discharge end of the washer. The drive motor is coupled direct to a speed reducer equipped with an overhanging sprocket on which rides the chain driving the drum.

Another interesting view is shown of a drive for a section of conveyor which elevates the boxes from the floor level as they are discharged from the main traffic elevator serving the various floors in the building. The conveyor and motor are suspended separately from the ceiling, the motor, of course, being attached to the suspended platform and driving the conveyor by means of the chain connection.

Cut-outs imbedded in this slat-conveyor apron open the control circuit of the conveyor drive shown in the background.

Working out an effective system, no matter how simple it appears, is anything but a simple problem. There must be considered the space factor, uninterrupted production, proper maintenance, and various other factors of equal importance, all of which tend to further complicate the problem, thereby keeping the result in doubt until the unit is placed into operation. In this installation a 40 per cent increase in capacity has been provided with a substantial reduction in labor operating expense.

Other applications of modern equipment are of equal importance. In the wood-working department, for instance, a completed operation which formerly required 48 hours is now accomplished in 48 minutes. It is the cash drawer assembly line which is shown in accompanying views. The operation proceeds from assembly of parts to the end of the wood-slat conveyor shown in one of the views at which point the assembled drawer is ready for sanding.

As a preventive against discharging the material over the end of the conveyor two push-button stops have been imbedded in the conveyor apron over which the drawers are forced to pass. The weight of the drawer is sufficient to operate the cut-out which returns to its original position when the weight has been removed. However, the drive must be started by the operator from his position at the sander. This conveyor is wide enough for two rows of drawers, consequently the two cut-outs shown are spaced accordingly.

A close-up of this drive mechanism is shown to emphasize the means that have been provided to synchronize or gear production to a predetermined value. This drive consists of a variable speed transmission and a fixed speed reducer interspersed between the motor and the conveyor in addition to the speed reduction obtained by the use of chains and sprockets. Gravity rollers carry the drawers to succeeding operations in line thereby replacing trucking.

As the drawer progresses to completion it is sprayed and equipped with the necessary hardware. The conveyor shown in the foreground of one view is used for the paint spraying and drying operations only. The hook upon which the hanger is suspended is swiveled to permit the drawer to make the turns in the drying tunnel without damage to the finish.

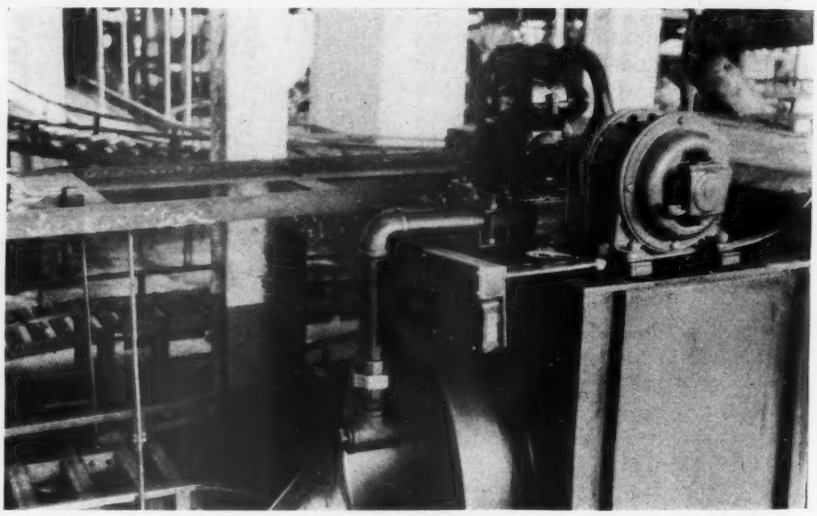
Entering the spray booth, the drawer first passes over steam coils of the fin type where it is heated and then sprayed. It is again heated to dry the first coat before it is given the second coat. The ability to speed up this operation is due principally to the lacquer used, but the use of the conveyor must not be discounted. Heated air is forced into this spray booth in excess of the requirements

Hand trucks modernized by short sections of chain by which they attached to an overhead conveyor.

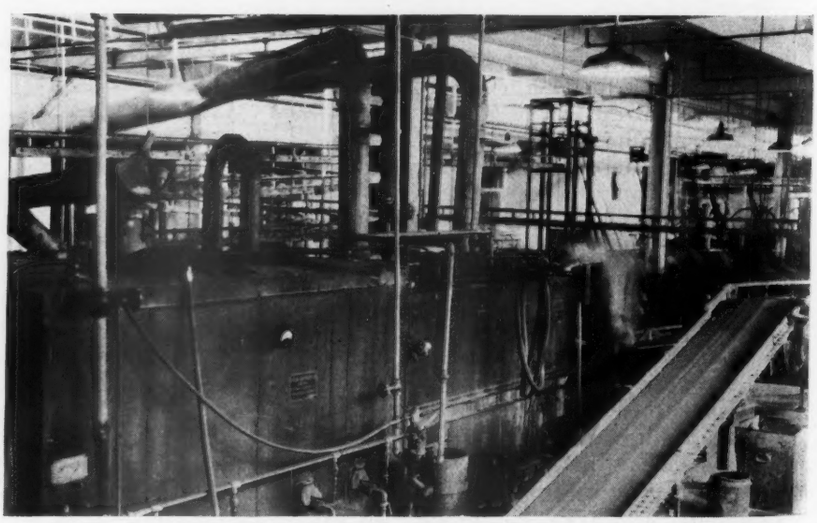
in order to create sufficient pressure to prevent air from entering from the outside carrying dust and other foreign matter with it. Spray fumes are exhausted to the atmosphere through ducts and filters provided for that purpose.

Another specific installation is that in the wood-finishing department where the time to finish one piece has been reduced from 84 to 36 hours. By means of the overhead conveyor 1,300 ft. in length, shown in an accompanying view, this department has reduced the floor space formerly required, increased production, reduced labor expense considerably, eliminated the necessity for trucking, and made unnecessary the need for parts storage. The parts are furnished on requisition for a stated order, completed and despatched on a specified schedule. One of the difficulties encountered before the advent of the conveyor was the need for sufficient trucks and, with the installation of the conveyor, what to do with the trucks. This problem was solved very simply by the use of short sections of chain by which the truck holding the finished parts is attached to the conveyor hooks and is despatched from the raw-part end, through the three drying ovens and out to final inspection.

Still another application of unusual interest is that in the carburizing department where electric carburizing furnaces have been installed. Supporting this operation are mechanical and electrical aids exclusive of the furnace equipment. Here nearly 8,000 different parts that go to make up a cash register receive

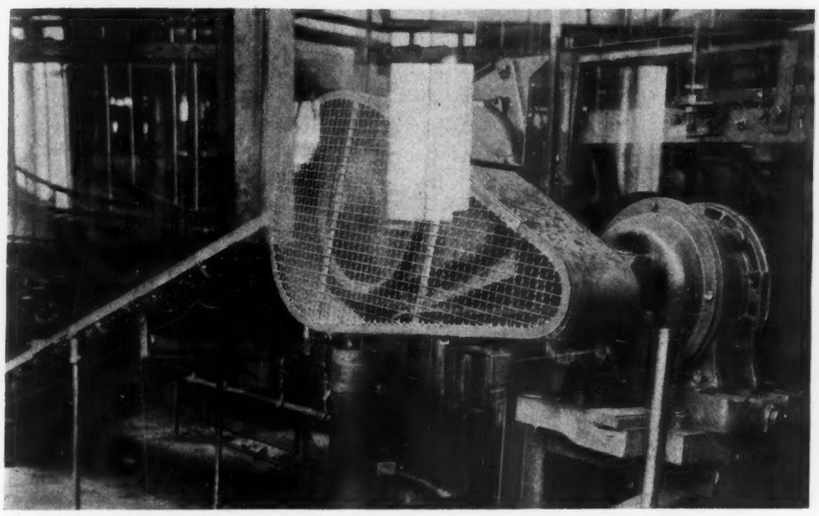


Drive arrangement of rotary drum at discharge end of washer.

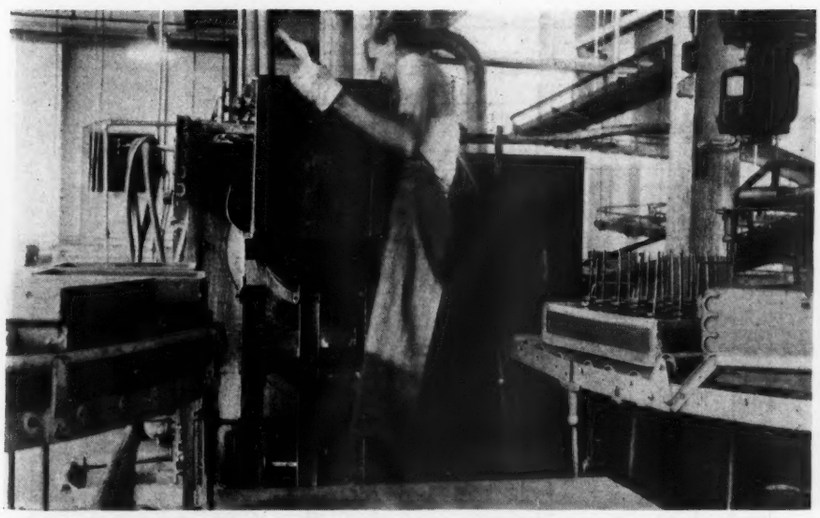


Small-parts washer showing outgoing belt conveyor at right.

Loading a 60-kw. furnace in the carburizing department with the overhead traveling charging crane.



Drive for feeder conveyor serving main vertical elevator.



The operator feeding the washer has three sources to draw from.

some degree of heat-treatment. In order to confine the hardening to machined surfaces the piece is copper plated and the plating removed where hardening is desired. Treatments include the use of salts, charcoal, lead, cyanide, and saltpeter. Work to be carburized is packed in steel pots that are slid from the bench to the roller conveyor beside the furnace. The charging crane shown places these pots in the furnaces.

At the end of the heat the pots are removed from the furnace by the crane and allowed to cool on the gravity conveyor leading to the cleaning table. The cleaning process consists of separating the metal parts from the carburizing material, which is done by means of an electromagnet suspended from an overhead trolley. With a few passes of the magnet the steel parts are extracted. The carburizing material is pushed into the hopper at the end of the cleaning table from where it is carried by air to a cyclone hopper located near the roof and which feeds the trunk lines at the packing benches. In this manner an ever-ready supply of carburizing material is available and to which is added fresh material to keep up the specified strength. Little or no loss results except that part which is consumed in the carburizing process.

So it is with many similar examples, proving that modernization of departments as to the handling of materials and parts produces tangible results beyond question. Certainly what is of benefit to the larger plant could be of proportionate benefit to the smaller plant.

A Practical-Ideal Organization for Plant Engineering

Composite of Fifteen Organizations

By L. C. MORROW
Editor, Industrial Engineering

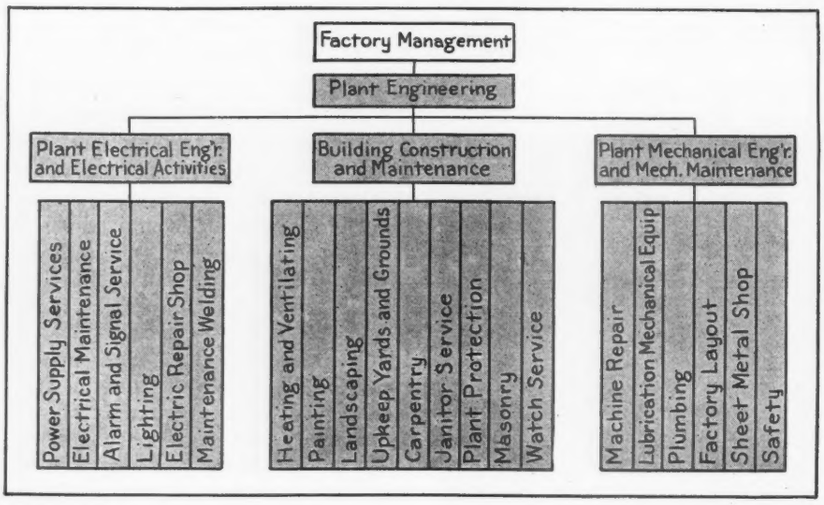


Fig. 1—Composite chart of the plant engineering function.

WHAT is the modern conception of plant engineering, and what is the modern set-up of the department responsible for the function?

Industrial Engineering has obtained the answers to these questions from 15 plants producing a variety of products. Relatively large plants were chosen in order to have in effect in each of them all of the details of the function. It will be an easy matter for smaller plants to disregard activities with which they are not concerned.

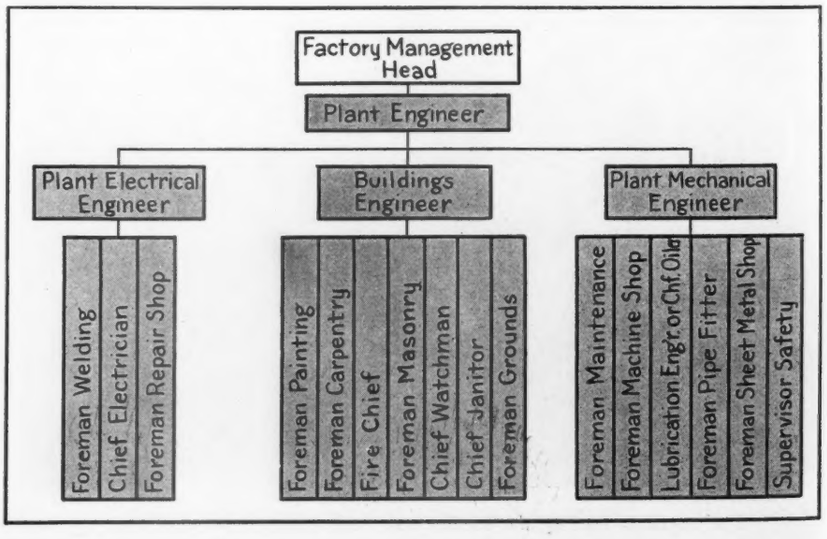
The details of the information collected by *Industrial Engineering* are given in the accompanying tables. From Table I it is evident that industry today separates certain plant activities from production activity and lumps them under the control of an individual. What are those activities? What is the individual called? To whom does he report?

Analysis of Table I shows that the activities listed in the column, "Kinds of Work Included as Part of Plant Engineering Function," include

Superintendence of buildings
Maintenance of buildings
Plant electrical engineering
Machine repair
Millwrighting
Plant mechanical engineering
Building service
Electricians' activities
Carpentry
Maintenance
Janitor service
Plumbing
Painting
Plant inspection
Landscaping
Upkeep of grounds
Factory layout
Plant protection
Pipe fitting
Tinsmithing
Masonry
Watch service
Safety

From the same table it is seen that the individuals responsible for the

Fig. 2—Composite chart of the personnel of the plant engineering department.



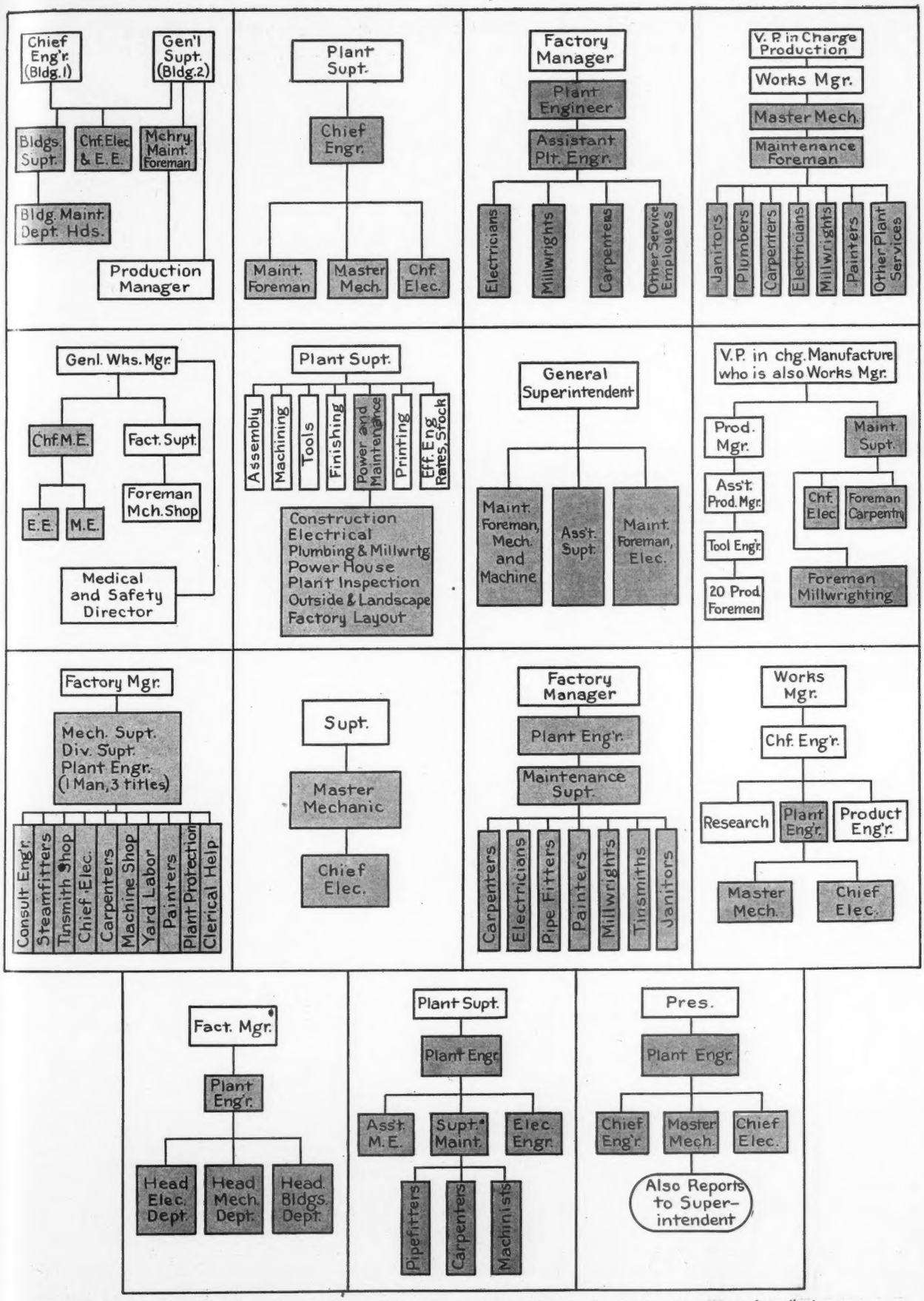


Fig. 3—Organization charts of the fifteen plants. To avoid complication the details of gangs, such as "painters, plumbers, pipe fitters, electricians, etc.," have been omitted from some of the charts.

Table I—The Place of the Plant Engineering Function in 15 Plants

Size of Plant		Products Manufactured	Title of Individual in Charge of the Plant Engineering Function	Kind of Work Included as part of the Plant Engineering Function	Position of Plant Engineering Organization to Organization as a Whole
Number of Employees	Motor Horsepower				
15,000	18,000	Automobiles	Plant Engineer	Electrical, mechanical, and building maintenance.	Plant engineer reports to factory manager.
7,700	11,512	Cash Registers	Maintenance Engineer	Electrical, plumbing, millwrighting, plant inspection, outside and landscape, factory layout, power house, construction.	Maintenance engineer reports to plant superintendent.
4,200	4,650	Automobiles	Plant Engineer	Maintenance (electrical, carpentry, pipe fitting, painting, millwrighting, tinsmithing, janitor service).	Plant engineer reports to factory manager.
2,100	9,000	Steel Building Materials	Chief Mechanical Engineer	Plant electrical engineering, plant mechanical engineering, both including maintenance.	Chief mechanical engineer reports to general works manager.
2,000	1,600	Vacuum Cleaners	Maintenance Superintendent	Millwrighting, carpentry, electrical.	Maintenance superintendent reports to vice-president in charge of manufacture, who is also works manager.
1,500	315	Inter-plant Communication Systems	Plant Engineer	Mechanical maintenance, electrical maintenance, carpentry.	Plant engineer reports to factory manager.
800	1,500	Nitrocellulose, Acid	Master Mechanic	Mechanical and electrical maintenance.	Master mechanic reports to assistant superintendent.
800	750	Gasoline Motors	Master Mechanic	Electrical and mechanical maintenance, plumbing, carpentry, millwrighting, painting, janitor service.	Master mechanic reports to works manager.
800	650	Cameras	Buildings Superintendent, Chief Electrician, and Machinery Maintenance Superintendent.	Building superintendence and maintenance, plant electrical engineering, machine repair and other mechanical maintenance.	The function is divided among three men whose activities are coordinated by the chief engineer and general superintendent.
600	7,000	Linoleum	Plant Engineer	Plant electrical engineering, power plant, safety, maintenance, pipe fitting, carpentry, machine shop.	Plant engineer reports to plant superintendent.
600	900	Locomotive Cranes and Steam Shovels	Maintenance Foreman, Mechanical and machine; and Maintenance Foreman, Electrical.	Mechanical and building maintenance, electrical maintenance, millwrighting, carpentry.	Both maintenance foremen report to the general superintendent.
560	1,000	Rubber Products	Plant Engineer	Electrical maintenance, mechanical maintenance, millwrighting, carpentry, painting, pipe fitting, masonry, janitor service.	Plant engineer reports to chief engineer.
550	2,000	Wringers, Mouse and Rat Traps, Hockey Sticks	Chief Engineer	Master mechanic's duties, maintenance foreman's duties, electrical foreman's duties.	Chief engineer reports to plant superintendent.
300	1,650	Confectionery	Plant Engineer	Consulting engineer's duties, chief electrician's duties, carpentry, yard labor, plant protection, painting, machine shop, steam fitting, tinsmithing.	Plant engineer reports to factory manager. Plant engineer is also mechanical and division superintendent.
160	3,500	Paper	Plant Engineer	Chief engineer's duties, chief electrician's duties, and master mechanic's duties.	Plant engineer reports to president; master mechanic reports jointly to plant engineer and supt.
37,670	64,027	Total plant employees and motor horsepower represented by the 15 plants.			

Table II—Equipment for which Plant Engineering Organization Is a Factor in Selection

Kind of Equipment	✓ Indicates Conditions in 15 Plants															Total	%
Motors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15	100
Motor generators and converters		✓			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	11	73
Control equipment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15	100
Panel boards and switches	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15	100
Wire, cable, wiring devices, fuses, etc.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15	100
Transformers					✓	✓	✓	✓	Part	✓	✓	✓	✓	✓	✓	10	67
Storage batteries and charging equipment					✓	✓	✓	✓		✓	None		✓		✓	7	47
Electric instruments, meters, and protective devices	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	13	87
Electrical repair shop	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	None	13	87
What proportion of electrical work is done by outside electrical contractors?		All Big		Small	None			Rewind	Rewind	None	Winding		Rewind Instrum Rep.	Large Work	All		
Transmission belting	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	13	87
V-belt drives		✓	✓		✓	✓	✓		✓	✓	✓	✓	✓		✓	11	73
Pulleys, hangers and shaftings	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	14	93
Automatic idler systems	✓	✓			✓	✓	✓		✓	None	✓	✓	✓		✓	11	73
Speed reducers		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12	80
Variable speed transmission		✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	11	73
Chain drives	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	12	80
Couplings	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	14	93
Gears and sprockets	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	12	80
Bearings, ball, roller sleeve and special	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15	100
Clutches	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	13	87
Belt lacers and fasteners	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	14	93
Mechanical repair shop	✓	✓	✓	✓	Fact. supv.		✓	✓	✓	✓	✓	✓	✓	✓	✓	14	93
Are welding repairs made in plant?	Yes	No	Yes	Yes	Yes		Yes	Some	Yes	Yes	Yes		Yes	Yes	No	10	67
What proportion of mechanical work is sent to outside shops?		Little		None	None		5%	None	None	5%	None			Large Work	10%		
Lubricants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	Part	✓	✓	✓	✓	14	93
Lubricating devices		✓	✓	✓	✓	✓	✓	✓	✓	✓	Part	✓	✓	✓	✓	13	87
Pumps and tanks for lubricants	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	14	93
Oil purifiers		✓	✓		✓	✓	✓	✓			✓	✓	✓		None	9	60
Conveyors					None	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	10	67
What types are used						Chain	Heavy	Belt	Belt	Belt	All	Light	All	Belt	Belt		
						Roller		Gravity	Gravity	Worm				Spiral			
						Belt											
Hoists and cranes		✓			✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	11	73
Overhead cranes		✓			✓	✓	✓	✓		✓	✓		✓		✓	9	60
Industrial trucks and tractors	✓	None	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	11	73
Skids and tote boxes	✓		✓		✓	✓	✓	✓	✓	None	✓	✓	✓		✓	11	73
Elevators in plant	✓	✓	✓		None	✓		✓	✓	None	None		✓	✓	✓	9	60
Unit heaters	✓	✓		✓	None		✓	✓	✓	✓	✓	✓	✓	✓	✓	12	80
Other plant heating		✓			✓		✓	✓	✓	✓	✓		✓	✓	✓	10	67
Ventilating equipment		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	12	80
Humidifying and dehumidifying apparatus		None			None		None	✓	✓		None	✓	✓	✓	None	5	33
Fire protection equipment	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15	100
Sprinklers		✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	12	80
Hand extinguishers		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	13	87
Hose lines		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	13	87
Alarm systems		✓		✓	✓	✓	✓	✓		✓	✓	✓	✓		None	10	67
Other		✓				✓	✓			Deluge	✓		✓		None		
Paints for plant	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	12	80
Is plant painting done by plant engineering forces?	Yes	Yes	Contracted		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Part	11	73
Is spray painting used?	Yes	Yes			Little	Yes	Yes	Some	Yes	Yes	Yes	Yes	Yes		No	9	60
Plant lighting	✓	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	12	80
Inside	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	13	87
Flood and other outside lighting	✓	✓		✓	✓		✓	✓		✓	✓		✓	✓	None	10	67
Signal systems	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		None	13	87
Service pumps	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	13	87
Air compressors	✓	✓		✓	✓		✓	✓	✓	✓	None	✓	✓	✓	✓	12	80
Partitioning		✓		✓			✓	✓	✓	✓	✓	✓	✓		✓	10	67
Safety guards and enclosures	✓		✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	12	80
Is plant cleaning under direction of plant engineering organization?				Yes	No	Yes	Yes	Yes	Yes	Outside	Yes	Yes	Yes	No	No	8	53
Is equipment cleaning under direction of plant engineering organization?				No	No	No		Yes	Yes		Depts.		No	No	No	2	13
Is plant engineering organization responsible for satisfactory service from Roofs	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15	100
Sash	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15	100
Floors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15	100
Siding	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	13	87
Ventilators	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	14	93
Water tanks	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	15	100
Fence	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	13	87
Bins and shelving	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	12	80
Mechanically operated doors		✓						✓		✓	✓		✓		✓	6	40
For what type of construction is plant engineering organization responsible?	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	14	93
Building alteration		✓	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	12	80
Minor construction			✓			✓				✓	✓		✓		Part	5	33
New plants																	
															Average ----	11.77	78.5

function of plant engineering are titled in this way:

1 chief mechanical engineer
1 chief engineer
1 maintenance engineer
1 maintenance superintendent
1 { buildings superintendent, chief electrician, machinery maintenance superintendent } 3 men
1 { maintenance foreman, mechanical and machine; maintenance foreman, electrical } 2 men
2 master mechanic
7 plant engineer

And, once again from Table I, it is found that of these men who head up the plant engineering

1 reports to the president
1 reports to the vice-president in charge of manufacture who is also works manager
1 reports to the assistant superintendent
1 reports to the works manager
1 reports to the general works manager
1 reports to the chief engineer
1 reports to the chief engineer general superintendent } 2 men
1 reports to the general superintendent
3 report to the plant superintendent
4 report to the factory manager

By reducing the kinds of work to a common denominator, so far as possible, and breaking certain of the terms into component parts, the simplified analysis appears like this:

KINDS OF WORK INCLUDED AS PART OF THE PLANT ENGINEERING FUNCTION

Building Maintenance, Supervision, and Service (including heating and ventilating, painting, carpentry, plumbing, plant protection, masonry and foundation work, watch service, janitor service, landscaping, upkeep of yards and grounds).

Plant Electrical Engineering and Electricians' Activities. (Specification, selection, installation, maintenance of all electrical equipment, including substations, drives, signal and alarm systems, welding, lighting.)

Plant Mechanical Engineering and Mechanical Maintenance (including specification, selection, installation, and maintenance of mechanical power drives and transmission equipment; machine repair; lubrication of equipment; factory layout; sheet metal work; safety).

It is evident from an examination of the titles of the men to whom the plant engineering individuals report that the majority are executive heads, performing the functions commonly belonging to the "factory manager." It is established, therefore, that

The men responsible for the function of plant engineering report to the executive in charge of factory management.

What responsibility other than that of seeing that work gets done have these men charged with the plant engineering? How great is their influence when it comes to saying how things shall be done and with what tools they shall be done? Table II answers these questions. The checks were put down in accordance with the instructions: *"Check equipment for which plant engineering organization is a factor in selection as well as being responsible for installation and maintenance."*

An examination of this table shows clearly that the plant engineer has a deciding voice in the selection of the equipment that he must install and maintain. Except for the fact that some kinds of equipment are not in use in some of the plants there would be even more checks. In adding for totals, and in figuring percentages (the last two columns on the right) no allowance was made for not using equipment; percentages are based on 15 as 100 per cent.

The preceding analysis of the facts presented in the two tables, when presented graphically, gives the functional chart shown in Fig. 1 and the personnel chart shown in Fig. 2 as results. They may be classified as "practical-ideal" charts, since they are composites of 15 existing arrangements that are working satisfactorily.

Just how close to the ideal the plant engineering organizations of the 15 plants are operating may be determined by comparison with the accompanying charts of the 15 plants. Observe that the plant engineering department may be headed by one, two, or three men. All three arrangments are working satisfactorily, but it is the author's observation that there is a tendency to adopt the single-head plan, particularly in large plants.

National Industrial Exposition

ARRANGEMENTS have been completed for the first showing of the National Industrial Exposition, which will be held March 3-7 inc., 1930, in the Hotel Stevens' exhibition hall, Chicago, Illinois.

It is the intention of the exposition to cover the field of materials, designs and methods now being proposed in industrial plant construction, operation, management, production, maintenance. The exhibits will cover a wide range of industrial equipment, including systems pertaining to cost records, production control, budgets, time and labor saving studies and various other plans and methods now being recommended for better supervision and more accurate cost knowledge.

Eighth National Power Show

PLANT engineers and others, who are desirous of keeping abreast of the times in engineering progress will again have an opportunity to view industrial equipment at the Eighth National Exposition of Power and Mechanical Engineering, which is to be held during the week of December 2nd at the Grand Central Palace, New York City.

The Power Show should appeal to plant engineers especially, as it affords a means of information on the latest phases of plant equipment, and by comparison with their own plant needs they are in a better position to recommend replacements for plant betterment. Three floors in the Grand Central Palace will be devoted to exhibition purposes.

Annual meetings of the American Society of Refrigerating Engineers and the American Society of Mechanical Engineers will be held in New York City during the week of the Power Show.

Upon LUBRICATION Depends Continuity of Production

When equipment is down it isn't the cost of repair that counts—it's the cost of lost production

LITERALLY, continuity of production depends upon thin films of oil, or grease. Almost every product of today is made by machinery, and the machine that will operate for any length of time without lubrication has not been invented.

As the *American Machinist* expressed this thought recently, "Modernization of plant equipment is the order of the day. New machinery, however, no matter how high its efficiency when in operation, is not an asset if it is subject to breakdowns or stoppages. In order to earn maximum dividends it must be capable of running continuously during the hours the plant is in operation. Continuous production frequently depends on a factor that has received too little attention in the past—positive and regular lubrication of all bearing surfaces. Unless ample provisions are made for thorough lubrication, new machine equipment may easily prove a disappointment."

To insure correct lubrication it is necessary that the right lubricant be selected; that the right lubricating system be employed; and that the system be operated at regular intervals to insure getting the lubricant to the bearings.

Selection of the lubricating system for new equipment is most frequently handled by the equipment designer, who, nevertheless, welcomes the influence of the user because of his constant contact with the equipment under actual working conditions. The acceptance of a limited number of systems as standard for his plant, for the purposes of economy in operation and inspection, also gives the user influence over the manufacturer in specification of the system.

For example, quoting from the statement of a superintendent of maintenance, published in *Industrial Engineering:* "The right lubricant and the right lubricating devices must be determined for each class of equipment. A copy of these standards is supplied when purchasing new equipment, and all our standard practices are incorporated by the machine builder."

For existing equipment the user must depend finally upon his own judgment in regard to the selection of the lubricating system suited to his specific needs.

It is not alone the accomplishment of getting the lubricant to the bearing that must be considered in the selection of a system. What shall be the frequency of attention in operating the system? Who shall do this work? Shall it all be done from the floor, or shall climbing to top of machine or to shaft be permitted? Must the system allow lubrication while the machinery is in operation? Is the product in process likely to be injured by superfluous lubrication? And a host of other questions.

Then the lubricant—shall it be oil, or grease? Heavy, light? Of high or low price? What about viscosity? Flash point? And the other characteristics for which there are accepted terms? The lubricating equipment can be seen and its design examined, but the lubricant, while it can be seen, remains a mystery to the average plant man. Fortunately for him, however, lubricant manufacturers and scientific bodies have expended much research upon lubricants with the result that there are available many data upon which he may make his decision.

Forty or fifty years ago the drilled oil hole was about all that was needed. Machines were simple, speeds were slow, caring for them was a leisurely operation. As time passed, plugs were put into the oil holes to keep out dirt. Covered oil cups and grease cups followed. Later on was witnessed the advent of flood and splash lubrication, centralized oiling, and pressure greasing.

Progress was slow until within the last few years. No one seemed to realize that the cost of holding up production should be the controlling influence in the expenditure of money for lubrication systems and lubricants. Bearings were considered inexpensive, lubricants dear, and lubricating systems a luxury. That attitude is changing rapidly. Now a policy of freedom approaching prodigality in the use of lubricants is in force in some plants. Lubricating systems are being installed at great initial expense. The position of lubrication engineer is being created in some of the largest plants, and capable men are being employed to fill it. Shut-downs are seriously frowned upon, even when the only loss of time is the substitution of stand-by equipment.

Industrial Engineering will publish during the first half of 1930 a series of articles dealing with lubricating systems and devices. The information presented will be so arranged that the series as a whole will constitute a compendium dealing with lubricating equipment, describing and illustrating types, and explaining them as to design, purpose and application.

This series will, in effect, be a continuation of the activities toward bringing about greater acceptance of policies favorable to modernization, which constitutes one of the regular functions of _Industrial Engineering_, and which is intensified in this issue.

Communication Within Industrial Plants

The pace of the industrial plant is proportionate to the completeness of its system of communication. Let the plant be otherwise up-to-date, the absence of a modern system of communication acts like a dragging brake.

By FRANK E. GOODING
Mechanical Engineer

TELEPHONES are by far the most widely used equipment for communication within industrial plants. There are types of service, however, where the telephone alone does not fulfill all requirements. In such cases the telephone can be provided with auxiliary equipment, as, for example, a paging device; or it may be necessary to install additional equipment of an entirely different type, as is required for transmitting messages which must be recorded.

The number of wires required and their arrangement vary with the system and usually with the number of telephones on the circuit except on common-talking, code-ringing systems, which require three wires common to all stations. Usually not more than six stations can be served by a common-talking, code-ringing system without interference. Where distance between the two farthest separated stations is not too great the system can be operated by dry batteries and the code sounded by pushing a button. There is shown in Fig. 1 two of the many types of telephone sets used without switchboards.

The objection to code-ringing may be overcome by using a "common-talking, selective-ringing" system so that any station can ring any other station without interference but only one conversation may be held at a time. By not connecting the ringing buttons in this system stations may be prevented from calling certain other stations; but they cannot be prevented from talking.

Where a large proportion of the calls originate at or are sent to a single station some form of the so-called "master and outlying stations" system may be used. The simplest form consists of a master station

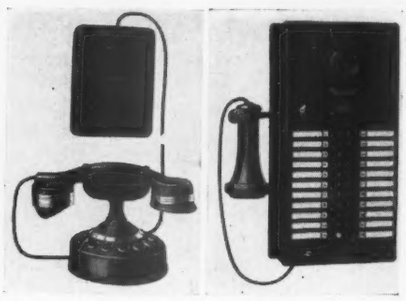


Fig. 1—Hand-set inter-communicating telephone (left) in cradle stand with pushbuttons in base for ringing. Selective-ringing, selective-talking wall telephone (right) with buttons for 22 stations.

* * * *

which can be called from all telephones on the system and may (or may not) be able to call all or some of the individual stations. This system is adaptable for central despatching or control, for use where reports must be received regularly by the master station from several points, but where there is no occasion for inter-communication between the various stations. Such a system is practically limited by the service conditions to about 12 stations.

The addition of an annunciator at the master station, Fig. 2, to indicate stations which have tried to make calls while the operator is away or busy, increases the number of stations which may be handled to about 20. The next step is to add connecting cords and provide jacks at the annunciator so that the various stations may be connected. Such service is limited to about 70 stations.

A special adaptation of the selective-ringing, selective-talking telephone system with a loud-speaking receiver is used in plants for executives' private telephone service, conference service, and in some cases to inter-connect the telephones in the entire plant. The executive calls any sub-station from his master station by operating the proper key. Calls between the master station and any other master or sub-station are secret. Calls are made between the substations on a common-talking, selective-ringing circuit. The sensitive transmitters are mounted in the face of the instrument which stands on the desk. The master stations have loud-speaking receivers so that it is unnecessary to hold the transmitter or the receiver while talking or listening. Lifting the ear phone from its hook, at the master station, Fig. 4, cuts out the loud-speaking receiver so that visitors in the office cannot hear the incoming conversation.

This system may be used in an installation with 40 or more telephones, all or part of which may be connected to the master station or stations, and to each other. The widest use is for private communication between higher executives, with facilities for the master to hold a telephone conference with from two to five executives at a time.

There is still another type of loud-speaking telephone which is used for paging, for inter-departmental communication, and for talking where it is not necessary for the individual to go to his desk and answer the telephone as he can receive his message and make his reply to the wall-mounted transmitting and receiving equipment.

Switchboards on private exchanges are of two types—"manual," which requires an operator to connect stations, and "automatic," which does not. Switchboards may be obtained

Fig. 2—Master station with annunciator to indicate source of calls attempted while operator is away from telephone.

Fig. 3—An eleven-party line substation without loud speaker as used with the master station.

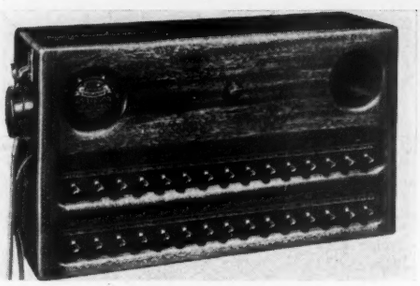


Fig. 4—One person can call or be connected with any of the 30 telephones on this master station.

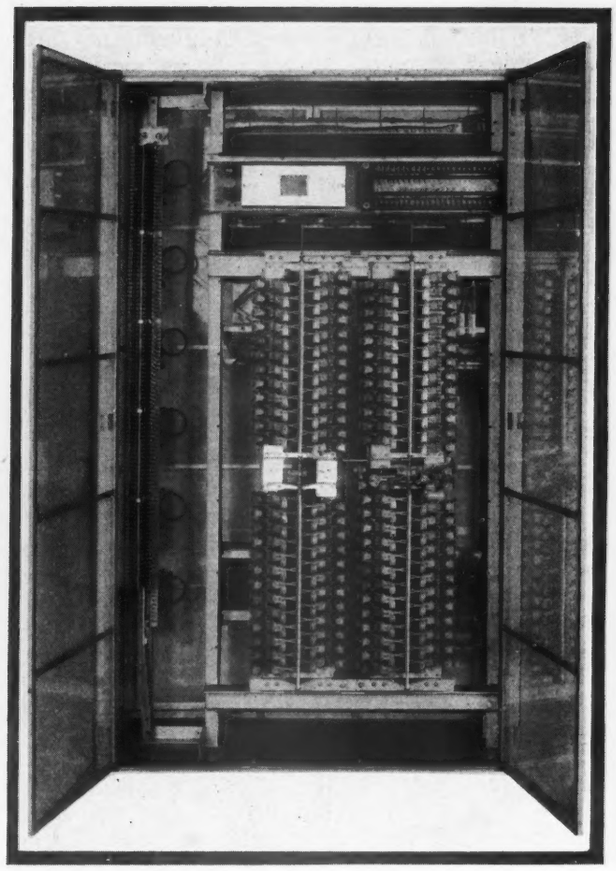


Fig. 5—Automatic switching unit for a private automatic exchange, with an initial capacity of 100 lines.

Fig. 6—A popular type of hand telephone desk set with transmitter, receiver, and dial, as used with an automatic telephone.

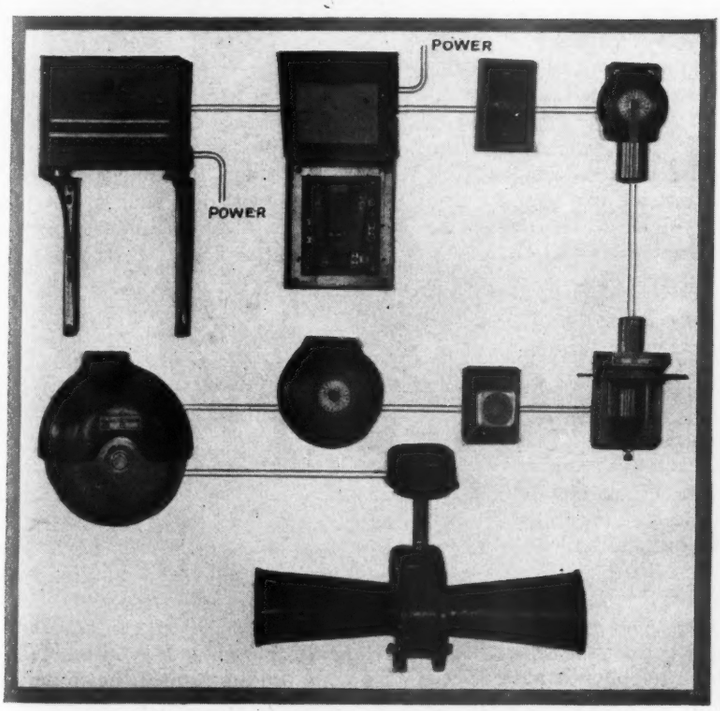


Fig. 7—Arrangement of bells and horns for code signaling.

Fig. 8—Code-calling sending station with capacity of 10 signals. This amount may be increased to 60 by adding standard units of control keys.

with a capacity of 10 lines up to about 100 lines, and may be increased by using multiple units.

An operator is necessary to receive incoming calls from outside the plant and to put them on the proper line with both manual and automatic installations. One of the advantages of the privately-owned, automatic-telephone system is that the exchange, or switching unit, Fig. 5, can be installed anywhere in the plant. There is shown in Fig. 6 one popular type of desk set used with automatic telephones.

Telephone Auxiliaries

There are limitations to telephone service. The ordinary telephone does not permit cutting into a busy line except through the intervention of the operator. It cannot reach an individual who is away from his instrument. With a few exceptions, conferences cannot be held over the telephone. The telephone, alone, is not fitted for watchmen's service. To obtain these services or advantages has led to the development of auxiliary devices.

The purpose of a selective talking circuit is to provide private, uninterrupted service. Sometimes an executive has an important matter which he wishes to take up immediately with one of the men on the line. On a common-talking circuit he can interrupt; if the circuit has a switchboard he can ask the operator to cut in. On the special system previously described the executive at the master station can signal to a substation even though the line is busy; this substation then quickly finishes or postpones the remainder of the conversation and calls the executive.

Automatic telephone systems may be provided with an "executive's right-of-way" feature built into the equipment so that a limited number of the executives can dial through existing connections and deliver their messages or ask one of the parties to hang up.

A method of handling a telephone conference is for the executive to have his secretary notify those who are to take part to dial on the automatic, at a specified time, a special conference number. Anyone can drop out by hanging up or others may dial into the conference without interference.

One of the serious shortcomings of the telephone is its inability to attract anyone who is not within hearing distance of his bell. Various types of paging or calling units have been developed as supplements. Emergency, fire, and program (starting and stopping) signals are generally broadcast on the same signal system. These systems, as used in connection with manually-operated switchboards, consist of a sending station mounted within reach of the telephone operator, and relays connecting to circuits throughout the plant with bells, horns, sirens or other signaling units so placed that one or more may be heard at any point. The signals are quite generally operated from power or light circuits and actuated through relays. Fig. 7 shows the arrangement of such a signaling circuit.

There are three types of paging equipment in general use. One type is built for a definite number of codes varying from 10 to 90 in the different sizes of units. The code is sent by the operator from the sending panel. The device can be set so that the code signal is repeated three times and then stopped or so that the code is repeated continuously until the operator stops it. This code-sending device may be used with a program clock, to give starting and dismissal signals. Also it may be connected to give the fire alarm signals in code.

The sending station of the second type, Fig. 8, is manufactured in unit sections. The two smallest units will send 10 to 20 codes; one or two additional units, each of a capacity of 20 codes, may be added to enlarge the system. Units of larger size may be made special. A call is sent by depressing a key. The call is repeated three times and then stops automatically.

Either of these two code-calling units may be arranged so that anyone on the outside can sound a code calling the night watchman to the entrance or notifying him that someone with a key is entering or leaving the plant.

Dial-Type Equipment

A third type of code calling equipment is entirely different from the two units described. This unit has two dials, each with a pointer. The pointers are set on the dials at the two digits in the code, the plunger depressed, and the code is repeated three times. This unit has a maximum capacity of thirty different calls. It may be operated from a dry battery or a bell transformer.

Automatic telephones have special attachments for connecting in the code-calling circuits. For one type of automatic telephone system provision can be made to install equipment which will send from 10 to 100 code signals. When a telephone call is not answered, the party calling dials a special code number which connects the code-sending unit, Fig. 9. This call is followed by dialing the code number of the party wanted, which sounds the code throughout the plant. The party called answers by taking any telephone and dialing the special "code answering" call, which stops the code signal and connects him to the party calling.

Counteracting Noise

The actual signaling on all code-calling or paging equipment is sounded through horns, bells, whistles, or other devices located throughout the plant. These signaling units must be suited to the conditions under which they operate; that is, they must be of an entirely different tone from that of the noise in the department. For example, bells, gongs, or toned bells are used in offices, the factory hospital, and other quiet parts of the plant. Horns of the vibrating or motor-driven types, Fig. 10, are used in the noisier locations, such as machine shops or where a large area as a yard or warehouse is to be covered. Horns are mounted as single units, two-way or three-way for projecting the signals in two or three directions simultaneously, and in swivel brackets, so that the direction can be changed. The siren is used where the signal is to be sounded over a wide area out of doors. Air and steam whistles and air horns with electrically-operated valves are used in extremely noisy locations, as in the noisier parts of a steel mill. In some extraordinary noisy locations, such as around a battery of steam hammers, operation has been found most satisfactory when an electrically-operated air whistle and a vibrating horn, operating in unison, are used.

Signaling equipment is made to operate on any voltage from 6 to 250, a.c. or d.c., and 25 to 60 cycles a.c. Standard voltage is 110, a.c. or d.c. and standard frequency is 60 cycles, a.c. The sending units are operated on dry or storage batteries, bell transformers, or direct from power or lighting circuits. Where only a few signals are operated they may be set in the sending circuit. Generally, relays are placed in the circuit from the code-sending units; the impulses to these relays control the current which operates the signaling units.

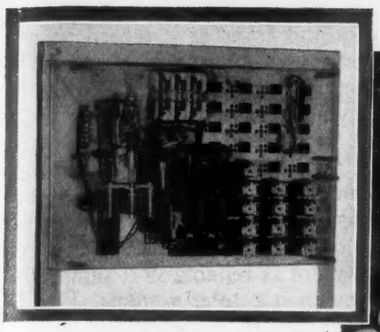


Fig. 9—Special panel for obtaining code calling or paging service.

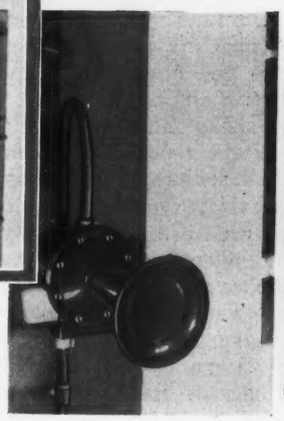
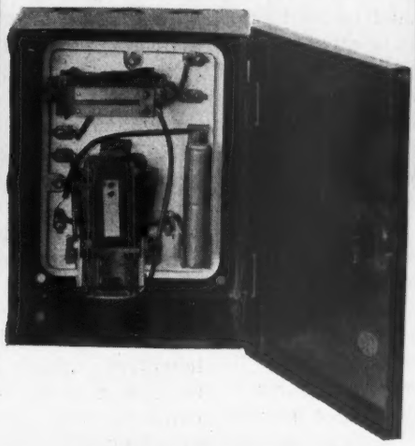


Fig. 10—Motor-driven howler used for all types of industrial signaling code calling, program signals and fire alarms.

Fig. 11.—Supersensitive relay used in heavily-loaded telephone lines for connecting in loud extension signals or code-calling circuits.



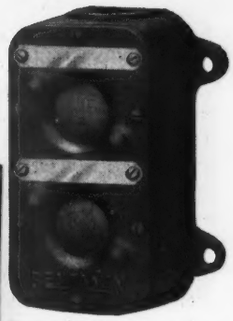


Fig. 12—Weather-proof pushbutton for operating signals in mines or out of doors.

Fig. 14—Pneumatic tubes are used for rapid transportation of messages and other papers.

Fig. 13—In case of machine trouble the machine operator notifies the central supervisor who checks the machine "time out" and calls the maintenance man by bell and visual signals.

Fig. 16—An operator typing a message which is duplicated by a similar machine at the other end of the line.

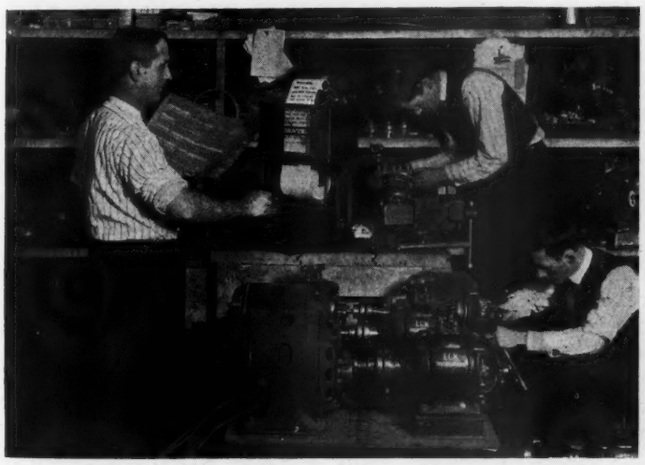


Fig. 15—Handwritten messages are duplicated at one or more receiving stations. This system establishes responsibility and overcomes the possibility of misunderstanding numbers.

Fig. 11 shows a type of sensitive relay for signaling service.

Because of the widespread application of horns in industrial signaling, a few precautions as to their use are mentioned. Direct-current horns operate well only when connected in multiple. Alternating-current horns operate in series, but it is not good practice to put signaling devices of different power demands together. Alternating-current horns are not put in series with single-stroke bells but can be put in series with a single lamp.

If the signal circuit is used for fire alarm service it must be in conduit to provide adequate protection. Otherwise low-tension signal lines may be in open wiring.

Pushbuttons, which are connected to bells, buzzers, annunciators, or other signaling devices, are widely used in offices to summon messengers or other subordinates, to indicate "in" or "out" on a central board, and sometimes for code signaling. Frequently batteries or transformers are used on push-button circuits but pushbuttons are made for use on 110-volt circuits. Fig. 12 shows a weatherproof pushbutton for use out of doors, in mines, and in other wet locations.

Desk pushbutton sets are made standard with up to 24 buttons. Pushbutton circuits and annunciators require an individual wire to each station and a common return wire. Annunciators are made with drops or lamps and may be connected into a telephone circuit.

Watchmen's service is an important type of inter-communication. In this type of service:

The watchman's report should be visual to a central supervisor.

It should indicate the location of the watchman.

The report should be recorded either automatically or manually or by both means.

It is desirable that some means should be provided so that the supervisor and the watchman on his route can call and talk to each other.

These features are obtained in a number of ways, sometimes by making use of the telephone and paging equipment in addition to a separate watch-reporting circuit. Generally, the same or correlated equipment has supervision over the watchmen as well as over the fire alarm system. In one system the report is printed in code on a tape which is visible temporarily to the supervisor so that he can keep a progress record. The watchmen talk to the supervisor over the watch circuit. On other systems visual reports are made on boards with drops or lamps and are automatically recorded on a chart. The supervisor resets the signal and keeps a progress record of the reports of the watchmen on their rounds.

Special watchmen's reporting equipment, which is used in connection with automatic telephone systems, has a special extra panel at the supervisory station. The watchmen report by dialing a special coding over the telephone circuits. The supervisor can dial back or dial to a telephone where he expects the watchman to be. Equipment is provided for making permanent records of the calls.

For Production Control

A special application of the dial telephone is used for production control. Instead of talking between stations, special codes and numbers indicating type of work or operation, services required, number of machine and operator, quantities, and other information, are dialed to or from a central supervisory station. This information is indicated on counters at the dialing station and at the supervisory station, where it is recorded. The time cards, job tickets, and other records are made out at the central supervisory station. Work orders are sent in a pneumatic tube to the foremen of the departments for their schedule boards. The switchboards for this production control system and the regular telephone system are placed alongside each other so that the two operators can relieve one another.

A machine operator can learn to dial the necessary information in a short time, even though the operator cannot speak English clearly enough to be understood over the telephone. No time is wasted in lengthy conversations because there is no transmitter.

An important part of this system is its control over maintenance. The machine operator can dial in code that the machine needs servicing and the class of trouble experienced. The supervisory operator signals to the maintenance man assigned to the particular class of trouble, on the visual indicator, Fig. 13. He reports to the supervisory operator by dialing his number at any of the machine operators' stations. The supervisor then dials back to him the number of the machine which requires service.

The inability of the telephone to make and transfer a record of conversations has led to the development of several types of special message-carrying equipment. The messenger boy, in connection with pushbuttons and annunciators, is one of the most common methods of carrying messages around the plant. This method is slow, rather expensive, and generally not as reliable as it should be.

Pneumatic tube systems, Fig. 14, have supplanted messenger boys in many plants. Tubes 2¼ in., 3 in., and 4 in. in diameter and 3x6-in. oval and 4x7-in. oval are the standard sizes. Standard carriers vary from 6 to 15 in. in length. Where only one tube is installed between two points it must be used for service in both directions. Heavy traffic requires twin tubes. They may be operated under vacuum, or pressure, or by a combination of the two.

Wire carrier systems are used in some plants for transferring messages or packages. They can be arranged for travel between a central station and an outlying station or can be continuous and automatically pick up and deposit papers or records at the various stations on the circuit.

One device, Fig. 15, duplicates a handwritten message at one or several receiving stations with a copy at the sending station. The reply is written out at a substation, which then becomes a sending station and is duplicated at one or more selected stations in the circuit. Handwritten messages assure responsibility and eliminate the likelihood of misunderstanding. Such equipment is extensively used in steel mills to report laboratory analyses to the production departments.

More recently the typewriter has been adapted to sending and receiving messages over telephone or telegraph circuits. The message is written on a special typewriter and duplicated at the receiving station on a continuous tape or on a page, Fig. 16, or sheet, or even on forms.

It must be remembered that the particular service required of any equipment should be considered in connection with the selection of any method of inter-communication. The telephone has become such a necessity that it must be included, but the user has a choice among the varieties of systems described. It is the problem of the plant engineer to match the particular requirements of his plant with the services rendered by types or classes of equipment and select that most suitable to his problems.

POWER TRANSMISSION

Through Speed Reducers and Variable Speed Units

By WILLIAM STANIAR

Chairman of the Advisory Board
Power Transmission Association
Power Transmission Engineer
E. I. du Pont de Nemours & Company and Subsidiaries, Wilmington, Del.

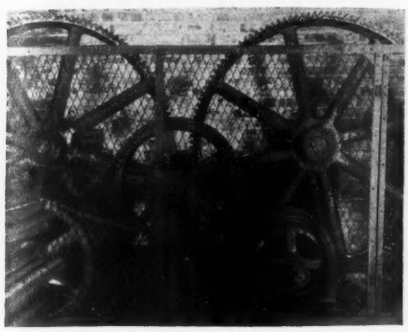


Fig. 1—High reduction ratios can be obtained in this way, but a modern speed reducer would accomplish the same results at much less cost for floor space and maintenance, and make a better looking installation.

IN many instances, electric motor speeds of 500 to 1,800 r.p.m. are entirely too high for industrial purposes; therefore, some means must be used to reduce such speeds to the required rates.

Ratios in single reductions up to 7 to 1 can efficiently be handled by belting, chains, or gearing and up to 12 to 1 by the same mediums, if absolutely necessary and efficiency is of minor consideration. Higher ratios than these require two or more reductions.

The modern speed-reduction gear unit has made possible the elimination of a multiplicity of chains, gears, shafting, and belting, for ratios such as 15 to 1 and higher. As an illustration, Fig. 1 shows a ratio from motor to application of 250 to 1, requiring two chain drives, large gearing, countershafting, etc. An installation such as this involves high maintenance and rapid depreciation. Speed-reduction gears would materially simplify this installation.

Modern speed-reduction units utilize four general types of gearing: namely, worm, spur, herringbone, and bevel. These types have been standardized so that they are available in suitable sizes and ratios for almost any power and speed reduction required. Each type has inherent limitations; therefore, care should be exercised before a selection is made for a particular requirement.

Catalogues of gear reduction units generally list the ratio, horsepower, and speed capacities. In a majority of cases, the rating represents the capacity of the unit when the materials composing it are stressed to the maximum safe stress allowable; no reserve exists for shock, overload, reversals, or loads from the outside. Therefore, the power capacity of the unit should be selected with a substantial factor of safety. This safety factor will, naturally, vary for each individual application.

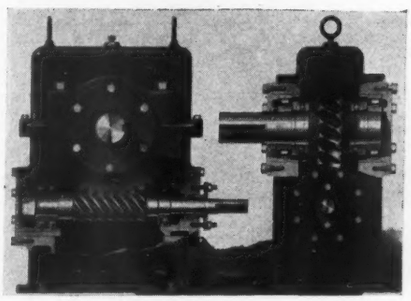


Fig. 2—In modern worm reduction units the worm shaft is supported on ball bearings. A double-row ball bearing is used at the rear to take the thrust load.

One of the most important factors in the successful operation of a speed-reduction gear is the connection to the motor and to the shaft of the driven machine. The flexible type of coupling is imperative at these points. It is not mechanically possible to align two shafts, each supported on its own bearings, so that both will revolve about the same axis. Unless some type of flexible coupling is employed between power source and reducer, and reducer and power application, the bearings of the motor, reduction gear, and driven machine will be subjected to extremely severe loads.

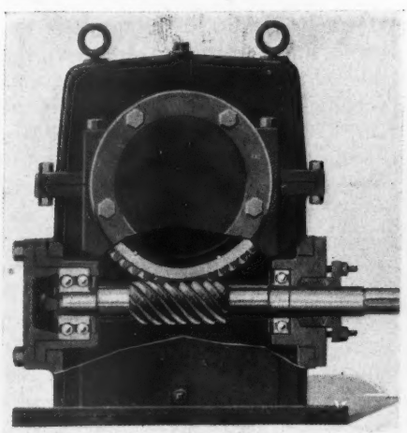


Fig. 3—A modern type of worm reduction unit showing construction of the worm and wheel shafts.

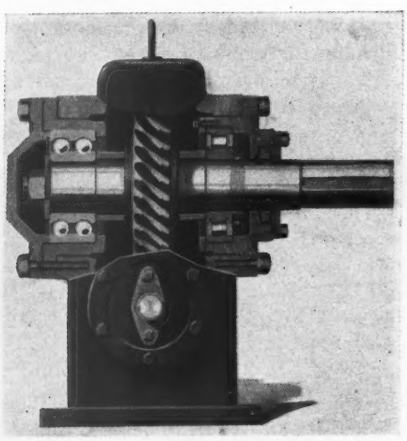


Fig. 4—The worm wheel shaft of this worm-gear reducer is supported on a roller bearing in front.

Worm-Gear Reduction Unit.—The worm gear consists essentially of some form of screw meshing with a toothed wheel and has been used for the transmission of motion for hundreds of years. Kinematically, this form of gearing has many advantages over other forms when the requirements call for a large reduction in speed in a small space, and when the driving and driven shaft are at right angles to each other.

The modern worm-gear speed reducer, types of which are shown in Figs. 2, 3, and 4, has been perfected to such an extent that it is extensively employed. Up to a few years ago the worm drive was in disrepute because the manufacturers had not recognized the fact that the efficiency of worm gearing is entirely dependent on the helix angle of the thread of the worm. It is now known that the greater the helix angle (up to about 42 deg.) the greater the efficiency; the smaller the angle, the greater the power loss. Generally, all manufacturers of the worm drive endeavor to use as steep a helix angle as possible. In the cheaper grades of worm reduction units this may not be done, with the result that a less efficient unit is produced.

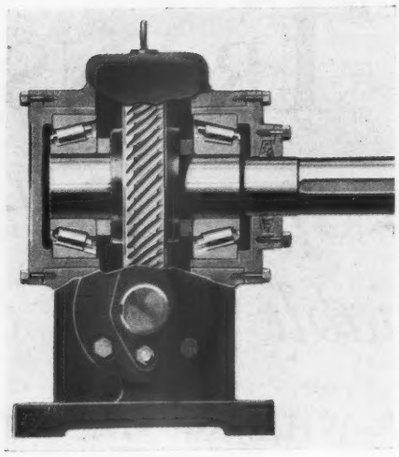


Fig. 5—Special construction of this worm gear reducer permits a pinion to be mounted on the slow-speed shaft.

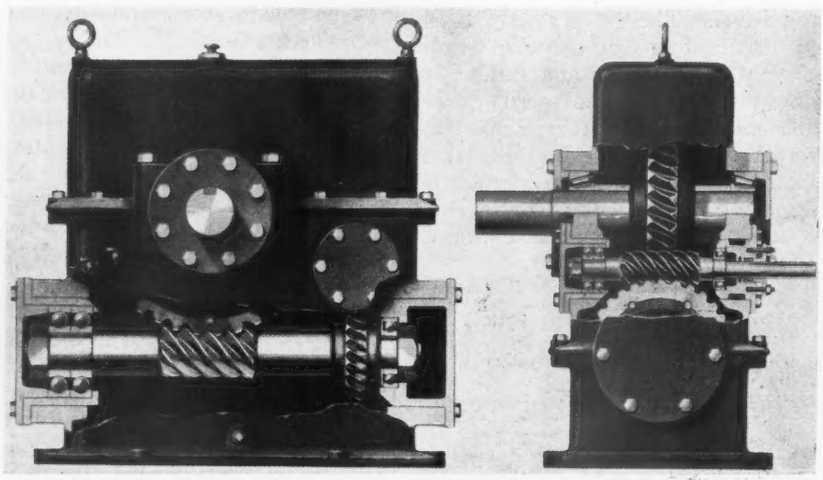


Fig. 6—Internal arrangement of the parts in a double-reduction, worm-gear unit designed to provide for a very high reduction in speed.

The worm of a first-class, modern reducer is usually integral with an alloy-steel shaft, with the threads hardened and ground. This combination is rigidly supported on ball or roller bearings, the rear bearing being of the double-row, maximum type, capable of carrying the full thrust load of the worm in either direction, as well as one-half the radial load. The other half of the radial load is taken by the forward bearing. The worm gear usually consists of a chilled, cast-bronze rim shrunk on and pinned to a high-grade, cast-iron center.

Although it is possible to obtain extremely large reductions with the worm and worm-gear drive, the power loss in the higher reductions precludes their economical application. Ratios of 60 or 70 to 1 are common, but beyond that point the efficiency drops rapidly. To obtain higher reductions and still retain the right-angle feature of the worm drive, two methods may be employed.

The more common method is to provide an auxiliary shaft supported independently, on which can be mounted a pinion which in turn meshes with another gear. A more recent method is to employ a specially-designed reduction unit with suitable bearings to permit mounting the pinion directly on the slow-speed shaft. This method is shown in Fig. 5. In Fig. 6 is illustrated a double worm-gear unit, by means of which it is possible to obtain a very high reduction in speed.

A single worm and gear can be made with a reduction ratio up to 80 or 100 to 1; the maximum reduction ratios possible with such a double reduction unit may, therefore, be as high as 10,000 to 1. The commercial sizes of worm gearing, however, do not permit the transmission of a great amount of power when the reduction ratio requirements approach these figures, because the torque for a given amount of power delivered at the gear shaft varies with the speed of the shaft.

The worm-gear reduction unit is essentially a right-angle drive, and the housings and gear arrangements are available in various forms to suit industrial requirements. In Fig. 7 is shown a compact form of a motor-driven, worm reduction unit, driving a large rotary kiln.

In Fig. 8 the internal arrangement of a vertical worm-gear reduction unit is shown.

Modern worm-gear reduction units can be operated at worm speeds up to 4,000 r.p.m. and are, therefore, suitable for direct connection to steam turbines. As mentioned before, the ratios available for a single worm and gear range from about 3 or 3½ to 1 up to 100 to 1.

In specifying the requirements for a worm-gear drive it is necessary that certain data, which should be as accurate as possible, be secured. In general the following information is required:

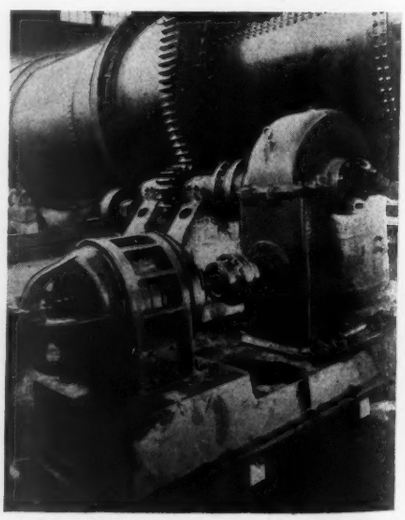


Fig. 7.—A motor-driven worm reduction unit for a large rotary kiln.

1. Horsepower of driving motor or driven shaft.

2. Actual horsepower to be transmitted.

3. Worm speed.

4. Gear-shaft speed.

5. Time during which unit will be in continuous operation.

6. Description of driven machine or character of service.

The power that can be transmitted through a worm-gear reduction unit depends upon all of these factors, among the most important of which is the character of the service. For the same horsepower, speed, and ratio a larger drive must be used on an application in which the load subjects the unit to shocks and impact.

The worm-reduction unit will not operate satisfactorily without oil. Its rotating parts must operate in a bath of oil, and the grade of such lubricant should be specified by the manufacturer of the reducer.

Spur-Gear Reduction Unit.—As the efficiency of the worm-gear reduction unit drops rapidly when ratios of 60 or 70 to 1 are exceeded, the spur-gear reduction unit has been evolved to cope with higher ratios. Ratios as low as 1 to 1 and as high as 500 to 1 are practicable with the modern spur-gear unit. This unit reduces in a straight line, which in many instances is more desirable than the right-angle feature of the worm-gear reducer. The spur-gear reducer can be classified into two distinct groups—the planetary and the non-planetary types—both having certain advantages.

The planetary type, shown in Fig. 9, is capable of giving the largest speed reduction. It consists of spur gears or idlers radially disposed about a central pinion and in turn meshing with a stationary internal gear. The idlers are mounted on studs that are rigidly fastened to a spider mounted upon the slow-speed shaft.

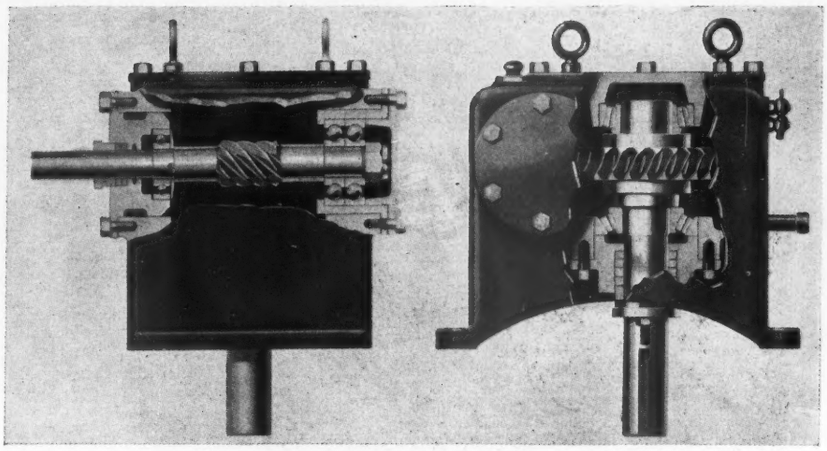


Fig. 8—Internal arrangement of the parts in a modern, vertical, worm reduction unit which features the right-angle drive.

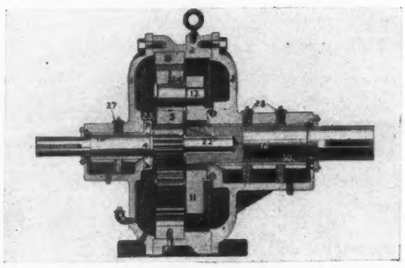


Fig. 9—A spur gear reduction unit of the planetary type.

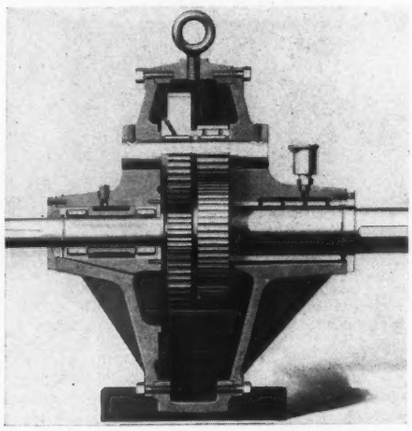


Fig. 10—Non-planetary type of spur gear reduction unit.

The planetary reducer with single reduction is satisfactory for ratios between 4 and 8 to 1, but should not be considered for ratios of less than 3 to 1. When a ratio of 8 to 1 is exceeded the reducer becomes rather large in diameter, and when the ratio is reduced below approximately 4 to 1, the speed at which the idler assembly revolves within the internal gear becomes excessive.

High ratios, such as 100, 200, 400, and 500 to 1 are obtainable in the planetary type of spur-gear reducer by the reductions being coupled in series in the same housing.

The non-planetary type of spur-gear reducer, Fig. 10, has the advantage of giving comparatively low reductions and keeping the rotational speeds at a minimum. Ratios as low as 1 to 1 and as high as 300 to 1 are practicable with the non-planetary system. This type consists usually of spur gears radially disposed about a central pinion. Each of the spur gears is keyed directly to pinions

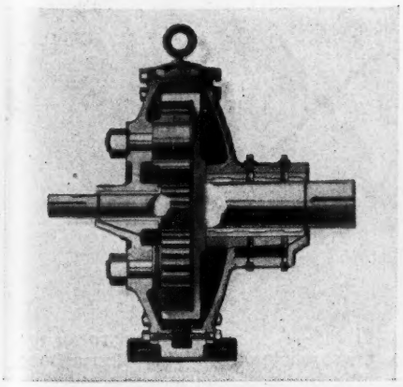


Fig.11—This non-planetary unit uses most of the planetary combinations.

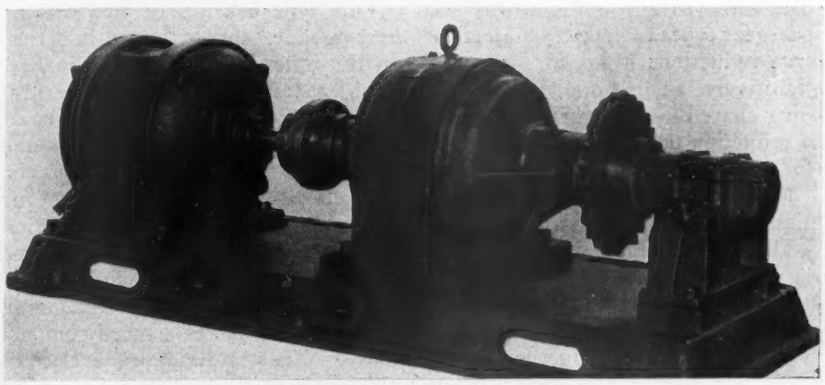


Fig. 12—A compact, motor-driven, spur gear reduction unit showing the method of mounting the power take-off on a common bedplate.

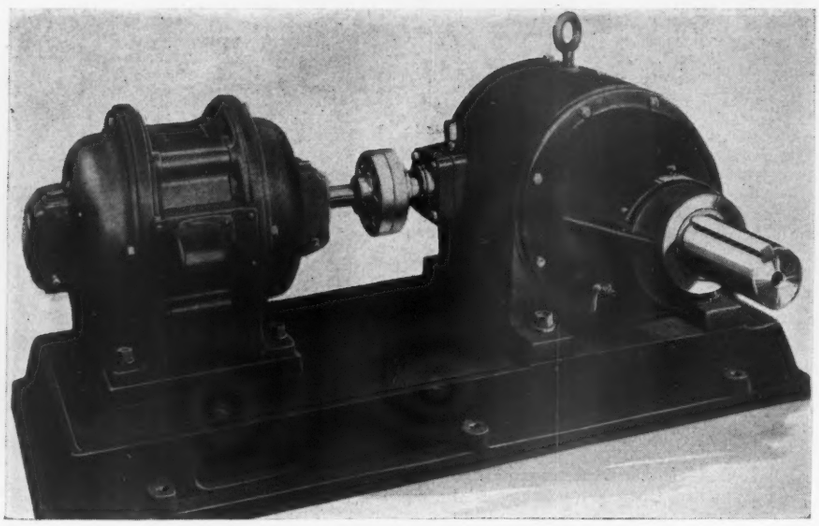


Fig. 13—If desired, a right-angled bevel gear drive may be mounted in the housing of the spur gear reduction unit.

which in turn mesh with a central gear mounted upon the slow-speed shaft.

There is another type of non-planetary drive employing all of the planetary combinations with the exception that the internal gear, which is keyed to the slow-speed shaft, is allowed to revolve, instead of the idler gear assembly as a whole. This type, Fig. 11, gives reduction ratios between 3 to 1 and approximately 7 to 1, which are intermediate between those obtainable with the non-planetary and the planetary types.

The best method of mounting the power take-off from the slow-speed shaft of the spur-gear reducer is shown in Fig. 12. It will be noted that the motor, reducer, and outboard bearing are consolidated into one unit by a common baseplate. Fig. 13 shows a more recent development of the spur-gear reduction unit, in which a right-angled bevel gear drive is incorporated in the same housing.

Herringbone-Reduction Unit.—Up to a few years ago the worm and spur-gear types of reduction units for large reductions in speed were used exclusively. This popularity is now being shared by the herringbone type of reduction unit, because it is highly efficient as well as silent in operation. It lends itself especially to the transmission of large powers.

The single-reduction type, consisting of one pinion and one gear, is commonly manufactured up to a ratio of about 7 or 8 to 1. In higher ratios the required reduction is generally obtained in two steps. There are two distinct types available.

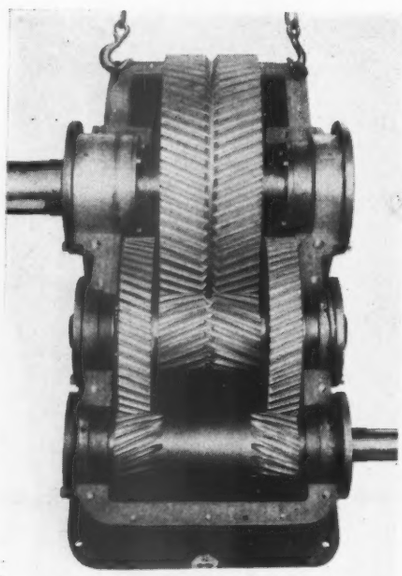


Fig. 14—This construction of a double-reduction herringbone reduction unit equalizes the bearing loads, and makes for compactness at high ratios.

* * * *

One type consists of two sets of herringbone gears arranged in series. In the other type, Fig. 14, the first set of gears is split; that is, the first drive really consists of two sets of helical gears, one set being cut one hand and the other being cut the opposite hand. They are mounted far enough apart to allow the insertion of the final drive pinion between the helical gears. This form of construction equalizes the loads on all bearings and makes a more compact drive. These two types are commonly manufactured in ratios up to about 60 to 1.

A recent modification of the herringbone reducer involves the use of spiral bevel gears for the first reduction. A unit of this type is shown in Fig. 15. The spiral bevel gear has been brought to a high state of perfection largely through its use in the automotive field. Its use in connection with the herringbone unit makes this type of drive available where a right-angled drive is imperative.

The herringbone-gear reducer is susceptible to the same influences as all other types of reduction units.

Variable-Speed Transformers

Variations in applied speed are frequently necessary to meet the requirements of industrial operations. When such variation is desired, the control must be rapid and easily accessible to the operator of the driven mechanism. Both electrical and mechanical methods have been devised for accomplishing this purpose. However, each system has its definite application and care should be exercised in making a selection.

Fine adjustment of speed is possible with modern variable-speed mechanisms.

A mechanical variable-speed transformer consists essentially of two parallel shafts mounted in a rigid frame, each of which carries a pair of cone-shaped disks with their apexes facing inward so as to form a spool-shaped pulley. Shifting levers hold the disks in place and also serve to vary the distance between the disks of each pair. A right- and left-hand shifting or speed-changing screw brings one pair of the disks closer together as the distance between the other pair is increased. An endless belt, wedge-shaped in cross-section, passes around the two

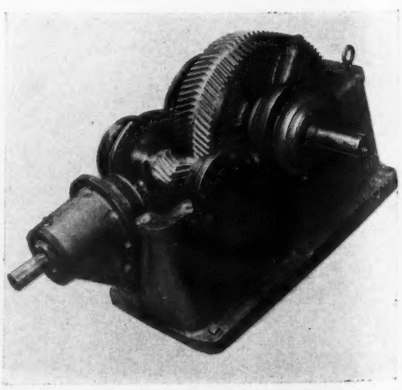


Fig. 15—A spiral bevel gear forms the first reduction in this herringbone reduction unit, and makes possible its use where a right-angled drive is necessary.

spool-shaped pulleys, the wrap about these pulleys being dependent upon the separation of the component disks. An infinite number of different speed ratios, with either pair of disks functioning as the high-speed member, is thus possible over the speed range of the device.

To secure any desired machine speed where the device is interposed between the power unit and the driven machine, either mechanical or electrical control can be employed. The control may be adjacent to the device or at any desired remote location; or the shifting of the disks can be performed automatically.

Modern speed transformers, Figs. 16 and 17, are compact, self-contained, mechanical units that receive power at a constant speed and deliver it any speed desired within the ratio of the device.

Mechanical speed transformers are manufactured in approximately 16 different sizes ranging from fractional horsepower to 150-hp. capacity and providing speed ratios from 2 to 1 up to 16 to 1 as minimum and maximum limits.

The average efficiency of the mechanical variable-speed transformer is about 96 per cent.

Variable-speed transformers can be controlled by hand, by remote electrical control, or automatically. When controlled by hand, a handwheel is provided directly on the machine, if the apparatus is in an accessible location. If the machine is hung on the ceiling, a sprocket is provided on the shifting screw, over which passes a chain to the hand-control sprocket below.

In many industrial operations where variable speeds are required, the speed transformer is of necessity placed at a considerable distance from the operator's position at the driven machine. For such installations, the electrical or remote control has been designed in order that the speed transformer may be used to its full advantage.

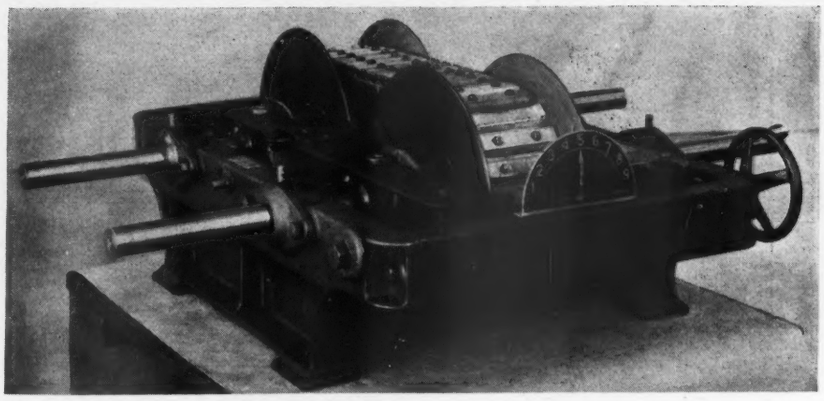


Fig. 16—Here is one type of mechanical, variable-speed transformer.

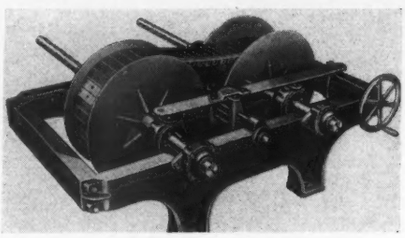


Fig. 17—Another type of mechanical, variable-speed transformer controlled by hand.

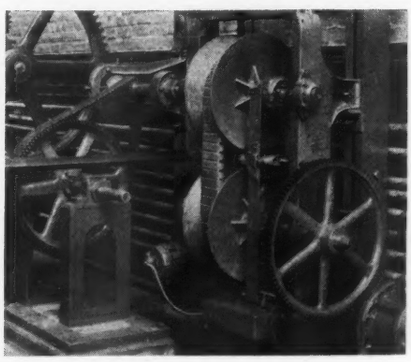


Fig. 18—Mechanical, variable-speed transformer of the vertical type with remote electrical control.

* * * *

Remote, electrical control of a variable-speed transformer is shown in Fig. 18. A fractional-horsepower, reversible motor is mounted on a bracket above the shifting screw of the transformer, and connected to it by a single spur-gear reduction. This motor can be started in either direction by one or more push-button stations operating through a mechanical switch. The mechanical switch, which is energized by the push-button station, is entirely self-contained in a housing that is integral with the frame of the transmission.

Two types of specially-constructed belts are used in the variable-speed transformer. The standard, rubber-body V-belt shown in Fig. 19 *A* consists of heavy-duty, rubber belt body. This rubber body is constructed to withstand shock loads and transmit the full horsepower of the speed mechanism with a large margin of safety. Hardwood locks are fastened at regular intervals to the belt body. Both ends of the wooden blocks are tapered and tipped with leather to conform to the V-angle of the speed-change disks. The V-belts for the smaller-sized machines have a single row of blocks, whereas those for the larger-capacity machines have a double row of blocks, one row above and one below the belt body.

The steel-link V-belt for speed transformers, Fig. 19 *B*, is the latest improvement for the belting of these machines. This type of speed-transformer belt is composed of hardened steel links flexibly bound together with rocker pins. The leather tips that give the tractive power are renewable and are securely cemented and riveted to the belt sides.

The modern variable-speed transformer can be used wherever variable speed is desired. In many applications it has taken the place of tapered cones, stepped cones, shifting gears, variable-speed electric motors, and variable-speed engines. It has solved the problem of fine speed control in a large number of applications in different industries.

Fig. 19—Types of belts used with mechanical, variable-speed transformers. The rubber body V-belt type is shown at the left. The belt shown at the right is composed of steel links faced on the side with leather tips.

Protect Production Against Fire

Provide the modern in plant construction and fire-fighting equipment

By A. C. HUTSON

Assistant Chief Engineer
The National Board of Fire Underwriters
New York, N. Y.

MANY of those living today can remember the time when all municipal fire departments were volunteer organizations, with gaudy uniforms, large silver trumpets and more zeal than effectiveness. Later, enormous concentration of values in the cities forced modernization of municipal protection, until today every municipality has its motor pumper, its quick-raising aerial ladder truck and other up-to-date equipment.

With all of these improvements, and the more general employment of paid men, the modern fire department is still handicapped in its fight against destruction by fire, and the death and injury of thousands of citizens. With fire losses keeping close to a half billion dollars a year there is need of strenuous action.

Obviously, large losses must occur only where values are high and concentrated. That means that our greatest losses are the result of the burning of large industrial plants, extensive stores, palatial dwellings, churches, schools and similar places.

Following an extensive fire in New York, which not only destroyed a half million dollars worth of goods, but caused the death of one man, Chief Kenlon of the fire department was heard to say, "We were licked before we arrived."

It might be asked why he made such a remark. The answer would be that, from his years of experience he realized, as few others could, the unbelievable conditions existing in many plants and buildings. He knew how the contents have been increased in quantity and value and the hazard thus increased, without proper consideration of the need for additional protection. By protection I mean not just the adding of fire-fighting units, but rather the more important feature of preventing the origin and spread of fire.

It is this last phase of fire protection that is in the greatest need of modernizing. Recognition of this

need is shown by the steps being taken to advance knowledge in corrective methods. Short courses in the training of firemen have been held in various states, under the auspices of the state universities and, through the efforts of the Fire Waste Council of the U. S. Chamber of Commerce, a program is being worked out for such a course in all the states.

All of this training, and that which supplements it through the extension courses for plant superintendents and foremen being given by such institutions as Rutgers College, in New Jersey, are leading up to a situation where the firemen can advise owners and operators of the needs of their plants.

Industry has somewhat overreached its safety factor in its efforts to increase production. Cutting cost is the dominating factor. Efficiency engineers lay out plans of operation with the main thought of reducing lost motion, which means concentrating processes, and usually values, and the routing of work with the minimum of transfer. Plants composed of several buildings, often so spaced as to make each a separate fire risk, are being replaced by one large building. Then storage of the raw material is integral with the hazards of the process of manufacture, and the finished product may be subject to a fire originating in some of the first processes.

Oftentimes much of the rebuilding must go hand in hand with manufacture, as the plant cannot shut down. Thus is the hazard of extraneous work added to that of the normal process; too often this is given little consideration and no special steps are taken to provide additional protection. In fact, much of this construction work not only increases the hazards of a fire originating, but also presents greater possibilities for the spread of fire through openings in floors and walls and through the temporary shutdown of such protective devices as the automatic sprinkler system.

Construction work always means the introduction of large amounts of woodwork for scaffolds, forms, and sometimes as permanent parts of the building. If avoidable, this lumber and building material should not be stored in the building.

Good modern practice is to use a form of fireproof wood, in connection with steel framing, for extensive scaffolding work. Many concerns are now insisting upon steel forms where concrete is being installed, especially where an addition is being placed on an operating factory or store.

Regardless of the method used, there are several essential precautions that should always be observed when construction work is being done. One of the most important is the installation of extinguishing devices. For small work, it is usually sufficient to place the ordinary 2½-gal. fire extinguisher at various handy places on each floor being worked on. When the work is done in freezing weather it is essential that these extinguishers be of the non-freezing type.

For higher buildings and those of considerable area, these extinguishers should be supplemented by carrying up a standpipe and hose system with the building as it is erected. To this must be added an adequate water supply.

The second feature considered essential is an adequate watch service, or at least a definite inspection of all parts of the building at quitting time to assure that nothing has been left which might cause fire.

The outstanding feature of modern fire protection is proper construction of the building. The nearer the building is constructed along the lines of the modern, fire-proof building the less chance there is of its being destroyed by fire. But this is not an essential, as there are many examples of excellent and safe buildings in which wood has been extensively used. These more readily burnable, or non-fireproof, buildings simply require more extensive fire protective equipment to make them suitable for the carrying on of a large and important business. In like manner, the steel frame and steel-covered building has its place in industry, where first cost must be considered and the hazard of the contents is not severe.

When buildings are close together the hazards of an exposure fire must be carefully considered. Here the spalling of the brickwork and warping of the iron shutters show the intense heat to which this building was exposed when a fire broke out in the next one to it.

With any type of construction there are certain fundamentals that must be taken into consideration. The first of these is that fire travels upward. It is, therefore, essential that every possible passage of flame from one story to those above be fire-stopped. This involves cutting off the passage of flame and smoke up elevators and stairs, preferably by inclosing them in walls, with proper firedoors at all openings. Fair protection can be obtained through trap doors on the elevators and single doors at the top of the stairs. Holes between floors are, however, a ready means of fire travel;

cases are on record where fire has involved an upper floor through a 2-in. hole left through a fireproof floor by the removal of a steam line.

The next important feature in fire protection is the reduction of the area that may become involved in a fire. This means the insertion of firewalls and fire partitions to cut up a large unbroken area filled with burnable material. In this connection it must be remembered that the reach of a stream from a fire hose seldom exceeds 50 ft., when the hose is on the same level with the fire. When the stream must be thrown from the ground to an upper story the reach is about 20 feet.

The third essential is the separation of extra-hazardous parts of the building from the remainder of the structure. Processes that include spray painting, dip-tank work, welding, and woodworking should be in separate buildings, or set off by fire partitions and firedoors. Processes that produce dust clouds introduce a severe explosion danger, and where pyroxylin plastic, sometimes called celluloid, is extensively used special care is necessary.

Modern heating systems and the various ventilating means now found in factories also involve hazards requiring special consideration. Many of these conditions are excellently covered by the Regulations of the National Board of Fire Underwriters.

Failure to design the plant properly for these hazardous classes of work is not the only feature of importance. A large element in the probability of fire originating and spreading lies in the plant housekeeping. Where this is poor and other conditions have not been properly cared for there is every possibility of a serious catastrophe.

Not only is it advisable to separate processes, but every plant must be safeguarded from its neighbors, and the different buildings of a plant from each other. A separation of 100 ft. will usually suffice, but this can seldom be obtained. It then becomes necessary to protect the building from an exposure fire. For this purpose the only proper procedure is to construct a brick or concrete wall of such thickness that it will not buckle under heat, and having as few openings as possible. Those openings which must be provided should have wired glass in metal frame, if the exposure is mild, and be supplemented with shutters or a water spray where it is severe.

The incendiary who tried to burn this lumber mill overlooked the sprinkler system. The pile of kindling in the foreground was soaked with oil and ignited, but a sprinkler head just above it opened and extinguished the blaze at once. The ice that covers everything in this picture will give some idea of the amount of water that was discharged by this one sprinkler.

In this connection it is well to remember that many buildings have ignited through wooden cornices and where exposure is severe it is advisable to finish off the wall with an ample parapet.

Next in importance is the fire protection that a modern industrial plant should have. Many fires are of small moment when they start, and can readily be extinguished. Even the small industrial plant should have a certain amount of equipment readily available. This in general means fire extinguishers, which have largely taken the place of the old-fashioned fire pail.

There are three general types of extinguishers: (1) those suitable for ordinary fires in free-burning material, such as packing cases, excelsior, paper, and so on; (2) those particularly suited to fires in flammable liquids, and (3) those for electrical fires. In general, an extinguisher that can be used on flammable liquids, such as the foam extinguisher, is also satisfactory for general fire use.

Extinguishers act in two general ways: (1) by cooling the burning material below the ignition point, and (2) by smothering the fire through the exclusion of, or dilution of, the oxygen in the air. The first type is represented by the stream of water from a hose or from a soda-acid extinguisher and, to a limited extent, by the foam from an extinguisher of that type. The extinguishers that smother are the foam type, the carbon dioxide type, and those that use a liquid, such as carbon tetrachloride, which is generally found in the small, 1-qt. extinguishers.

Many plants need some of all these types. Where electrical fires are expected, only the 1-qt. type and the carbon dioxide extinguisher should be used, as the mediums they employ are non-conductors of electricity and a person can apply them without danger of being shocked.

As was said above, even buildings of non-fireproof construction can be made secure against fire. This involves applying an extinguishing agent for every fire, at any time of day or night. Such protection is made possible through the installation of automatic sprinklers, which probably come closer to modernizing fire protection than any other device. With a properly installed system, and

for proper installation the Regulations of the National Board of Fire Underwriters should be followed, many of the deficiencies listed above can be offset.

It is essential that buildings of large area be so equipped, as by this means water can be put on a fire in the remote parts of the building. Furthermore, a sprinkler system can aid in stopping the upward travel of fire through stairways and other vertical openings.

Much could be written as to the advantages of automatic sprinklers, but the complete story is tersely told by reviewing the experience of the cotton mills of the country. For years the fire record of these mills was disastrous—so bad, in fact, that insurance was almost impossible to obtain. Inventive minds perfected the automatic sprinkler to the point where its operation is positive, with the result that the fire losses in this class of occupancy are now among the lowest.

A further safeguard of industry is available in fire alarm systems. In these days of excellent, well-equipped fire departments, it is essential that the local department be called for every fire, as there is no assurance that even a small blaze will not get beyond the control of the occupants of the building. A fire alarm system, in conjunction with watchman service, and operating through a supervisory central station, renders the best form of service for this purpose, unless an automatic fire alarm system is installed.

The latter consists of thermostats that are placed on the ceiling, and when heated by a fire transmit an alarm to the fire department. They are, in effect, silent watchmen and serve as one of the most effective fire protective devices on the market. Proper maintenance of these systems is highly important. Hence, it is advisable to take such service through one of the central station systems, where proper supervision can be assured.

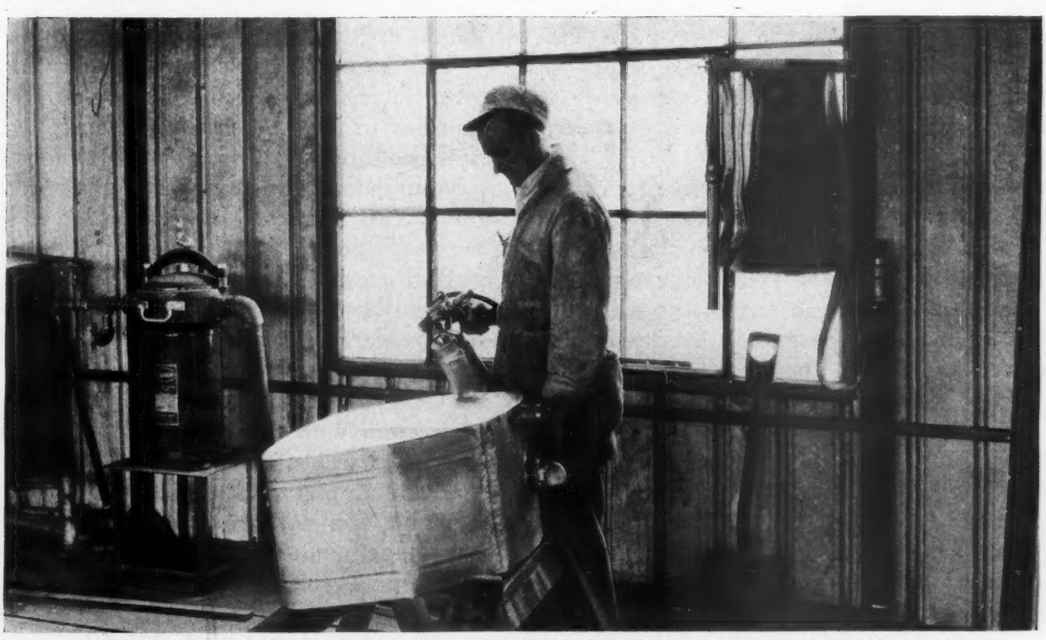
It is interesting to note that there have been two notable developments in the field of fire extinguishers during the past few years. One is a form of chemical extinguisher, made in the ordinary 2½-gal. size and in the larger wheeled extinguisher of 40-gal. capacity, which is not only non-freezing, and can be kept in unheated places, but its chemical solution, it is claimed, has about 40 per cent greater extinguishing power than plain water. This is known as the "loaded-stream" extinguisher.

The other is a development of the use of carbon dioxide, not only in the form of portable extinguishers, but as flooding systems for closed rooms, dip tanks, holds of vessels, bilge of motor boats, and compartments for various electrical devices. In particular, it is of value in telephone exchanges, as it does not harm the equipment.

A third form of extinguisher is being experimented with, but has not yet had the field service to assure that it will give perfect satisfaction. It employs a form of bicarbonate of soda, or ordinary cooking soda, that has been treated so that it will not cake and can be discharged or thrown as a powder. For discharge purposes, compressed nitrogen gas is used.

Another important development is a form of automatic sprinkler called, because of its method of operation, a "deluge system." Primarily it consists of open sprinklers; that is, those without the normal fuse strut. The piping system is normally dry and water is turned into it through the operation of a special valve and trip mechanism operated by thermostats placed at proper intervals on the ceiling. These thermostats operate on the rate-of-rise principle. They are set so that a rise in temperature at a rate per minute greater than that normal to the room will set them off.

Its ultimate development will probably be very great as it not only puts into operation an extinguishing agent, but can be used to close doors, open ventilators, stop motors and operate mechanical devices. It is also applicable to the flooding of rooms with carbon dioxide gas. Another important feature is that it will give an alarm, calling the fire department. In the final analysis, the latter is one of the most important of the modern protective features for any industrial plant.



Here is an installation of a foam type extinguisher to lessen the hazards of a paint-spraying operation in an airplane factory. The hose hanging in front of the window is connected to the generator, left, which produces 350 gal. of fire-smothering foam on one charge.

INDUSTRIAL ENGINEERING

Plant Engineering in Industry

L. C. MORROW, *Editor*

Chicago, October, 1929

Recommended—Exposure to the Modernization Germ

BACK twelve or thirteen years ago most of us had influenza—something new from a germ new to us. Not all who were exposed to the germ got the disease, but certainly no one not exposed acquired it.

And that's the point. Industrially, it's the same with ideas—there must be exposure to the idea germs, by travel, change of position, plant visits, contact with outsiders, reading.

Some years ago the waste elimination germ was rampant. It was a good germ, most of us caught it, and the world is better because we did. Same with the standardization and simplification germs, and others. Men who are progressive exposed themselves through the contacts mentioned.

Industrial Engineering has been a carrier of these beneficial idea-germs. More recently it carried the "Replacement" germ (March issue), and the "Severe Service" germ (June issue), and in this issue it carries the "Modernization" germ, tried, tested, and proved to have only good qualities. Thorough exposure is recommended.

Slow Driver—Slow Traffic

TWENTY miles an hour! How we berate the driver who snails along at that pace. He wants to go no place, and would force others to govern themselves by his inclination. Or perhaps he refuses to recognize that the speed of travel by automobile has been stepped up.

And the parallel in industry? There are many. There is the slow driver who holds his job because of long service, or poor judgment on the part of the man who pays him, or some other equally serious, foolish reason. He cannot, or will not, believe in the profit to be gained by preventive maintenance, inspection, performance records, replacement, modernization.

There is the slow driver who does not foot the bills for his men to get out into plants to see how other, and possibly brighter men, are doing things. His blood brother is the slow driver who will let no one into his plant because he thinks he knows how to do everything and wants to keep all of his processes secret.

There are the slow drivers who either do not believe in, or will not participate in, standardization, simplification, research, statistics.

There are the slow drivers who do not believe in, or do not understand, the advantages of high wages.

There are others—you'll think of them. And then, on the edge of industry, but not of it, is the slow driver who bewails the making of things by machinery and the consequent passing of handicraft.

Is fast driving recommended? Yes. The driver who stays out in front is not likely to be hit in the rear, or sideswiped.

But reckless driving, no. Staying in front by driving through signals and forcing others into the ditch of itself invites disaster.

And back-seat driving receives no recommendation—there's the man who decries machinery.

Some of these crude comparisons refer to functions of management, some to functions of plant operation. And that's quite all right, because the two can't often be separated.

Now their relation to modernization. Obsolete equipment and plant engineering methods—twenty miles an hour, danger of being hit in the rear and sideswiped. Modern equipment and methods, selected upon data based on statistics, research, standardization—fast, safe driving, with no attention to the back seat.

Electric Heat Belongs in the Modernized Program

IN any program of modernization that involves the substitution of electrical energy for other sources of power, or the replacement of obsolete types of electrical equipment with modern designs, the possibilities that lie in the use of electric heat should not be overlooked.

Thanks to the genius of Edison, industry was given a source of illumination that is vastly superior to anything used previously. The work of Tesla, Steinmetz, Lamme, and a host of others gave to industry the modern electric motor, which the great majority of plants have so wholeheartedly adopted.

But, great as are the advantages of these two applications of electrical energy, industry cannot be considered to have availed itself to the fullest extent of the possibilities latent in this familiar, but still mysterious, force until there is wider appreciation of the advantages of electric heat, and wider use of it.

With a long and constantly growing list of exacting applications to its credit, electric heat has helped industry to solve many troublesome problems involving the application of heat in manufacturing processes.

Gas, oil, and coal have their place in the industrial scheme and will, no doubt, continue to have wide use in certain types of applications. Never-

theless, when automatic and exact control of temperature is desired, or advantageous, along with freedom from fire or explosion hazards, absence of dust and fumes, lack of need for skilled attendance, and other advantages of consequence, electric heat may well be made the object of very careful investigation.

More Mechanical Handling—Fewer Accidents

ACCIDENTS reduced by half on account of the mechanical handling of materials in foundries is reported by the Metropolitan Life Insurance Company. The comparison is drawn between plants making use of and others making no use of mechanical materials handling equipment. Total number of accidents is the basis on which comparison was made.

We may reasonably expect similar conditions to prevail in the plants of other industries. Thus prevention of accidents is shown to be one of the factors that should influence industry in its consideration of mechanical handling equipment.

Good Lighting Increases Useful Work

IN THE design of a machine, higher efficiency is attained by decreasing the useless work done by the machine. Waste due to frictional losses is paid for but yields no returns. There is an analogy in the case of lighting and human workers. The workers are blind in the dark and their efficiency is curtailed in proportion to their dependence upon vision. If a match is lighted, vision begins to play a part, but certainly such meagre lighting does not make vision the most efficient. Immediately, the work done by an individual is seen to consist of two components: (1) the useful work which exhibits itself in production, and (2) the useless work which the individual performs without any resultant production.

When lighting is inadequate or improper, or both, the worker does not see easily, quickly, accurately and safely. He moves himself or his work to a better position. He squints his eyes and screws his head around to avoid glare. He holds the work closer to the eyes. He does many things which waste time and energy if the lighting is bad. This is useless work.

Thus it is seen that a lighting installation may be viewed either as an expense item or as a producing part of the payroll. First, to make lighting productive, it should be free from glare. Proper shades or diffusing units accomplish this. Then comes the consideration of adequacy of amount of light—foot-candles. Outdoors, human eyes evolved under thousands of foot-candles. Indoors, only a few foot-candles of artificial light are in general use. Those who have awakened to lighting as a producer—because it decreases the useless work done by workers—are increasing the intensities of illumination. In laboratories and in work-places it is being found that good lighting is productive and not merely expensive. Those responsible for lighting in industries should welcome this relatively new and justifiable viewpoint toward lighting.

How About Your Plant Fences?

THE jocose remark that a politician is "mending his fences" calls to mind an activity with which every plant engineer may well concern himself.

If children were not inquisitive, and every man were honest, there would be less need for fences. As it now is, the barrier interposed by a fence serves not only to protect the plant property against the malicious and thieving, but may protect from bodily harm the curious and ignorant trespasser. For some people "Keep Out" signs are a sufficient restraint against unauthorized entrance, but their effectiveness depends almost entirely on their reaction upon the individual mind. A strong fence does not depend on a psychological reaction for its value; it presents a physical barrier that even the dullest mind can comprehend without misunderstanding.

The losses that industrial plants suffer through theft and malicious damage are unquestionably very large. Against such losses a well-built fence is effective, if not perfect, protection. Fortunately, too, instead of necessarily being an eyesore, a fence designed with artistry and good taste may well add a valuable note of distinction and pride to an otherwise drab-looking plot of ground.

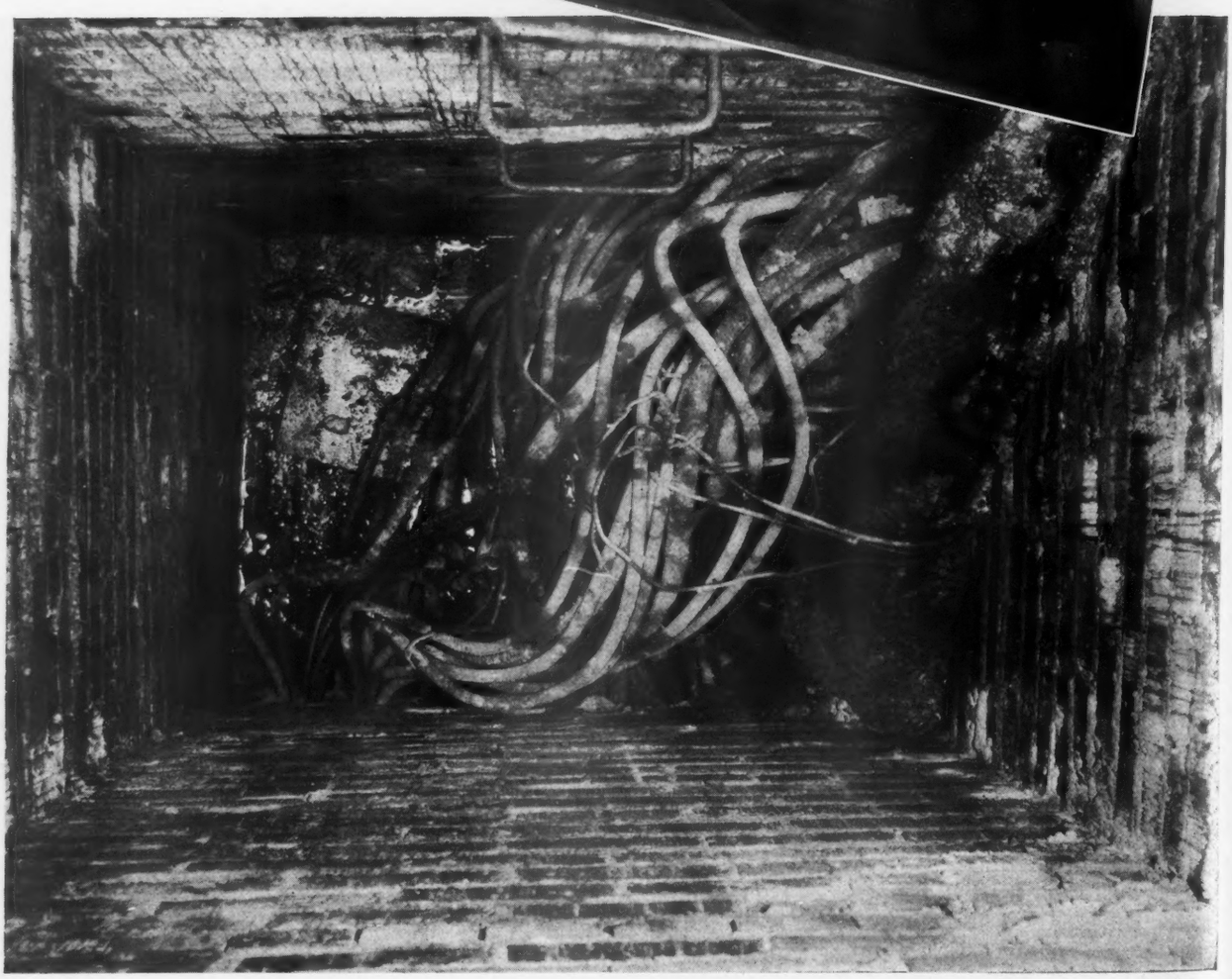
Conversely, a ramshackle, broken-down barrier around a plant must inevitably give the onlooker the impression that carelessness and slipshod ways of doing things are not out of place in that establishment.

Equipment manufacturers are constantly improving their products — modernizing them. *Industrial Engineering* announces the improvements, and new products, as they are introduced. In the January, 1930 issue, will be published brief descriptions of all the new equipment announced in *Industrial Engineering* during 1929—the issue will be a modern equipment service for readers.

Horrible Examples

of how not to arrange cables in manholes

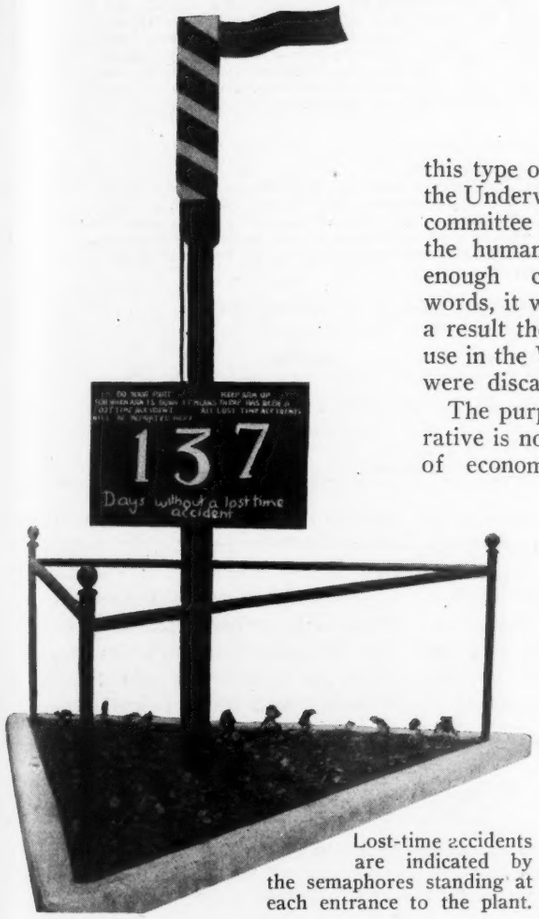
These illustrations show what one plant engineer was up against when he tackled a new job



And Safety in modernization

By H. P. OSBORNE

Secretary, Safety Committee
The Whiting Corporation
Harvey, Ill.



Lost-time accidents are indicated by the semaphores standing at each entrance to the plant.

A BLUE flash—a hissing pop—and two men were laid off with a combined doctor bill of $80.

It was the job of the safety committee to prevent accidents, or to prevent their repetition when they occurred through unforeseen circumstances. Investigating the foregoing incident, the committee traced the cause to a $10 economy in the purchasing department, which cannot be severely blamed, as will be discovered from the facts of the case.

A maintenance man was called upon to correct trouble with some fan equipment, and in looking for the trouble he removed the arc shield from the line starter. A short on the line caused the flash; both he and the operator were unprotected with the linestarter in this condition.

It was found that the starter was so constructed that it was frequently necessary to remove the arc shield when looking for trouble. Although this type of starter was approved by the Underwriters, the Whiting safety committee declared it unsafe, in that the human element was not given enough consideration; in other words, it was not fool proof, and as a result the only two of that type in use in the Whiting Corporation plant were discarded.

The purpose of the foregoing narrative is not to demonstrate the evils of economical purchasing departments, but to show that safety can be secured only by a program of constant and careful watchfulness.

When the Whiting Corporation plant was inspected by the Underwriters a few years ago it was declared to be one of the safest plants from the standpoint of equipment that had ever been observed. Yet in 1925 this "ideal" plant had 76 accidents, with 770 days lost time; in 1926, 104 accidents, with 1,412 days lost time; and in 1927, 48 accidents, with one death and 966 days lost time.

Then something happened. In 1928 the number of accidents dropped to 31 and the days lost to 275. Since Jan. 13 of this year there has been only one lost-time accident.

The something that happened was the establishment of the Whiting general safety committee. It is their duty to stir up interest and encourage suggestions for improvements. Their work is intended to be preventive, but it is unfortunately true that causes of all accidents are often not apparent until the accident has happened. In such cases the committee makes a real investigation, analyzing the accident to determine the cause without whitewashing anyone.

At its second meeting the committee was called upon to consider three accidents. One of these resulted in compelling all men working around hot metal to wear protective footgear. Another, which was classified as a "near-accident" since no actual injury resulted, brought a week layoff for the man involved because he was scuffling with another when he fell from a packing box. The third was less simple and was dealt with as shown by the accompanying report.

The work of the general safety committee was felt immediately, although it was not until a year later that a remarkable safety record was attained. During January and February of 1928, compensation for accidents was reduced by $1,182.81.

The big job of the committee was to capture the interest and imagination of the men, and the first step was one of organization. A "subsafety committee" was appointed, composed of men picked for their interest in safety. In addition to the honor of membership on the committee, these men shared in a bonus based on the savings achieved through safety. Cards were given to each man on which to write suggestions for improvement of safety conditions. Each man turned in one card each week. Failure to do so was taken as lack of interest, and the offender's name was removed from the roll of the committee, with consequent loss of his bonus.

Since from the standpoint of equipment the Whiting plant already met a high standard of safety, most of the activities of the committee were directed to an educational campaign against carelessness. One regulation dealt with the loading of trays used with electric trucks. If material is unsafely placed on a tray in one department and sent to another, the department receiving the tray is allowed to summon the man

who did the loading and compel him to unload. This and similar rules are now being incorporated in a pamphlet which will be placed in the hands of all employees.

The committee did, however, discover many chances for improvement in the safety of equipment. Drivers of the electric trucks sometimes skinned their knuckles when passing through the swinging doors leading from the plant to the material yard, so guards were provided on the handles of the trucks.

At all points in the plant where walks cross the switch tracks, black and white warning stripes were painted. Where these tracks ran close to a door, making it difficult for anyone coming out to see the track, a gate was installed.

The committee is now experimenting with a special tray for the electric trucks which will make it safer to carry loose castings.

In the fall of 1928 a drive for an entire month without a lost-time accident was started. Each month, however, some mischance marred the record, until February, 1929, closed without a blemish. A total of 47 days had passed without a lost-time accident.

January 9th, 1929

From: General Safety Committee
To: Factory Manager
Subject: Accident to F—— H—— #3606
Accident:

Attached is injury report showing "cut side of left eye". The explanation of how this accident could have been avoided is by being more careful, and it is further explained that this man attempted to catch a flask that was slipping from the chain on a lift and in so doing struck the left side of his head, causing slight injury. This accident could easily have been of a serious nature and we have been informed by W. J. W.——, Foreman, that this man was nearly injured a short time ago. In making a lift, he placed his hand under the chain and signalled the crane operator to make the lift and his hand was bruised, but only a slight injury resulted.

Recommendation:

It is the recommendation of the Committee that this man be transferred from his present position to one less hazardous, for instance; he could be used in cleaning wash rooms and miscellaneous odd jobs such as mowing lawns, etc. This man is past sixty (60) and was operated on not long ago for hernia, consequently, the work in which he is now engaged is too strenous and is apt to result in an accident of a serious nature.

The Committee requests you advise action taken by letter.

Chairman

The fact of a month without an accident had a wonderful effect on the attitude of employees throughout the plant. A bulletin distributed to all, cigars for the men, and candy for the women, served to give the event publicity and started everyone thinking of safety.

About this time the committee tried another feature to dramatize the safety record. A semaphore now stands at each entrance to the plant, with a sign explaining that the arm remains horizontal as long as there are no lost time accidents, and it shows in a space below the num-

Neat Yards Mark

A creosoting plant must necessarily devote more space to the storage of material than to buildings. If storage were not systematic and orderly, and if modern materials handling equipment were not used, the yards would look more like a huge scrap pile than part of an industrial plant.

WHITING SUB-SAFETY MEETING

The Whiting Sub-Safety Council Meeting was held in the Lunch Room Friday, June 7th at 4:40 P.M.

There were present:

O. E. Matthies, Chairman presiding	W. Jaeschke
H. O. Osborne	O. Schuman
W. C. Fairchild	E. Groskopf
J. B. Rodger	J. Pike
H. Maatman	A. Westerholm
W. Walsh	M. Salow
W. Jasson	W. Romine
E. Schroeder	R. Hayes
T. O'Connor	A. Young
A. Hayes	A. Bruggeman Absent

The meeting was opened by O. E. Matthies.

H. Mattman brought up the subject of the switch track in the east end of the East Shop as being a hazard. This is an old track the Steel Car used to have for unloading cars. W. J. Walsh says that it is in the B. & O. right-of-way.
Action: Track will be taken out in the near future.

O. E. Matthies mentioned the bad practice of several men on one floor signaling crane operators at the same time. This practice must be discontinued. W. E. Fairchild also mentioned in this connection that we are not using a standard set of crane signals. Mr. Matthies said that this is being taken care of in a set of rules now being drafted for our Safety manual.

W. Romine saw a man grinding on Polly's floor shooting sparks across the aisle. W. Schroeder said that he was instructing this man to use a screen at the time Mr. Romine spoke of.

H. P. Osborne gave the final details regarding the safety show.

O. E. Matthies called for volunteers to help at the show.

The meeting adjourned at 5:10.

ber of days since the last lost-time accident. The arm remained up for 150 days, when it was brought down by the carelessness of a truck driver. It has been up again for 116 days, and every effort is being made to break the former record.

The Whiting Corporation ranked first in the South-Urban Safety League for four consecutive months; February, March, April and May.

When the record reached 100 days without an accident, the safety committee held a celebration at one of the local theatres. Employees and their families were admitted free to a program of vaudeville and pictures. Professional performers shared honors with school children, who presented a safety pageant. A motion picture was selected which presented a safety moral ingeniously woven into an interesting human story. On reaching 150 days as a record, another "bigger and better Whiting jubilee" was held and to which all employees and their families were again invited.

The Whiting Corporation builds cranes, foundry equipment, railroad equipment, and other heavy machinery, and its subsidiaries manufacture chemical machinery, powdered coal equipment and stokers. More than 600 men and women are employed. The plant includes a foundry, a machine shop, two structural shops, assembly shops, forge shops, a pattern shop and extensive storage yards. In view of the size of the plant and the hazardous nature of some of the work, the company's safety record is even more remarkable.

Every employee is anxiously watching the semaphore now. We are getting close to our former record and hope to break it. We are thinking now, not of a month, but of a year without a lost-time accident.

the Modern Plant

The illustration shows the yard arrangement of the Taylor-Colquitt Company's plant in Spartanburg, S. C., where the products are creosoted Southern pine poles, piling, ties, and bridges. The capacity is 100 million feet board measure per year. The plant and yards cover 80 acres and contain 9 miles of standard gage railroad track.

Electrical Modernization

without production delays

By WM. B. FERGUSON

Works Electrical Engineer
Westinghouse Air Brake Company
Wilmerding, Pa.

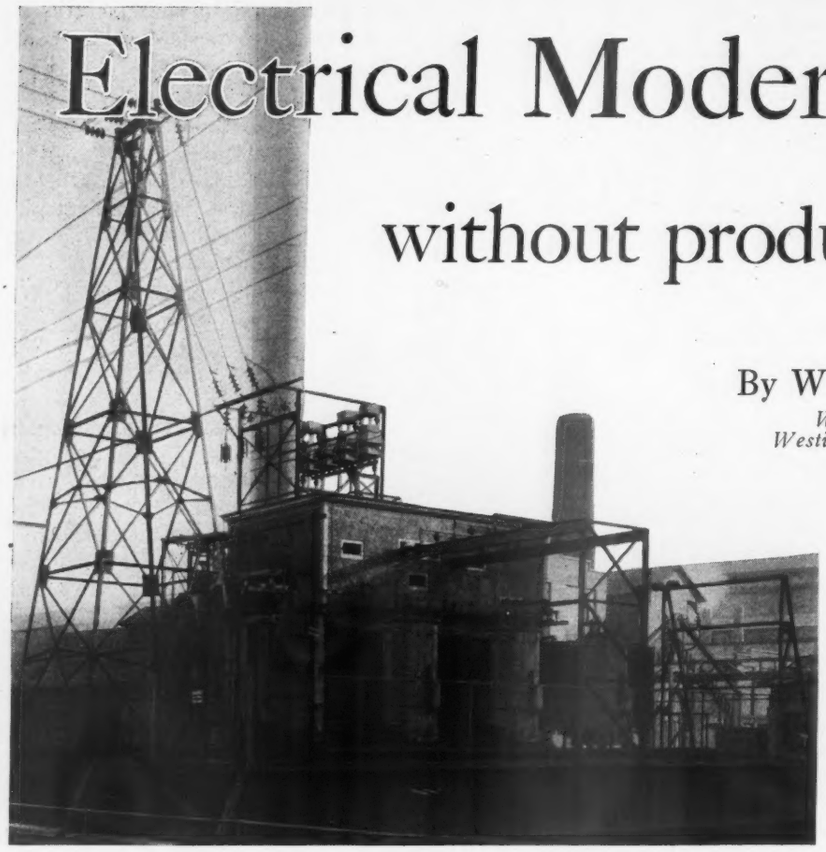


Fig. 1—The high-tension substation and transformer bridge, showing the one incoming 22-kv. aerial line. The other line feeding this substation is underground.

MODERNIZING the electrical equipment of a plant may not present any particularly difficult problems if the process is a gradual one and extends over a long period. However, to change all of the electrical equipment in a large plant over to a different system is another matter. Furthermore, to do the work within a limited time, and without interrupting production, presents many problems that are not easily solved. That is the situation which confronted us.

Naturally, the equipment that was originally installed in a plant that has been in existence for a good many years represents what was available, and perhaps the best that was to be had, at that time. Nevertheless, constantly-increasing skill in the design and manufacture of equipment render the best types obsolete in time. In our case, all of the original equipment was of two-phase design. Hence, in view of the fact that it is now much more difficult to secure two-phase apparatus, which at best possesses certain disadvantages as compared with three-phase equipment, it was decided to change our plant over completely to three phase.

Before going into the details of how the job was handled, it may be interesting to note that since changing over we have reduced the cost of power from $0.0145 per kilowatt-hour to $0.0102 per kilowatt-hour, raised our power factor from about 69 per cent to an average last year of 93 per cent, cut the number of burnouts to less than 0.5 per cent, and reduced the cost of motor rewinds nearly 45 per cent.

This modernization program meant a complete departure from our former method of handling power. We eliminated our power house and in its place erected the rather novel substation shown in Fig. 1 above.

This transformer station, which is of 10,000-kva. capacity, is fed by one 22-kv. underground line from the Duquesne Light Company's substation and by one aerial line of the same capacity, originating at the same substation, but fed from a different source. These two lines are looped through our substation, both lines being controlled separately by automatic breakers that are also electrically controlled from our switching station, which is located in a building some 250 ft. distant.

The primary feeds three 3,333-kva. transformers; a fourth transformer is held on the bridge for use as a spare in case of trouble with any of the others. All of the four transformers are mounted on trucks, so that by means of a run-off car they can quickly be removed from the bridge.

From the bridge we carry our secondary bus through the wall of the building, shown in Fig. 1, to a 3,000-amp. totalizing secondary breaker and thence to the switching room through six 500,000-circ. mil cables, which terminate on the switch room bus.

In Fig. 2 is shown the interior of our new switching room which controls the two incoming 22-kv. feeders, as well as the fifteen feeder circuits that serve the plant. The equipment mounted therein is all electrically operated.

The panelboards, in this room, have their terminal strips at the top, instead of the bottom, as is customary. This arrangement was used to eliminate the danger of bumping the terminal studs when sweeping or cleaning behind the board.

Our breaker structure is designed to give men who are working on the equipment while it is hot plenty of room to move around in, and the switching is arranged so that the feeders may be kept alive while the breakers are cold. This feature is accomplished by means of single-pole, single-throw disconnect switches and selector-type discon-

nects, as shown in Fig. 3, which gives the single-line diagram of our feeder layout.

The battery used for breaker control is housed in a separate compartment in the distribution room, being ventilated to the outside. Although the battery is intended primarily for breaker operation, it is also used for emergency lighting in the switching room.

Our outgoing feeders are individually controlled, as shown on the system layout in Fig. 3, the feeders terminating at the several transformer banks or at large motors, as the case may be. We put any motor that is of more than 100-hp. rating directly on the 2,300-volt service, whenever the cable runs are not excessively long. Anything smaller goes on the 440-volt service. The entire plant load is split up to what we feel is the practicable limit in order to minimize shutdowns. We have not had a shutdown since the new system was installed and placed in service.

In Fig. 4 is shown a typical transformer bank to which one power feeder cable (three phase) and one single-phase lighting service cable feed directly from the switching station. This particular bank has a capacity of 750 kva. for power service and 150 kva. for lighting service, with an electric furnace lead tapped off of the primary bus.

The lighting transformers are all handled through high-voltage fuses and disconnects at each bank, which gives us individual protection and allows us to sectionalize the lights, which are fed on three circuits from the station.

In Fig. 4 a mine-type telephone will be noticed in the foreground,

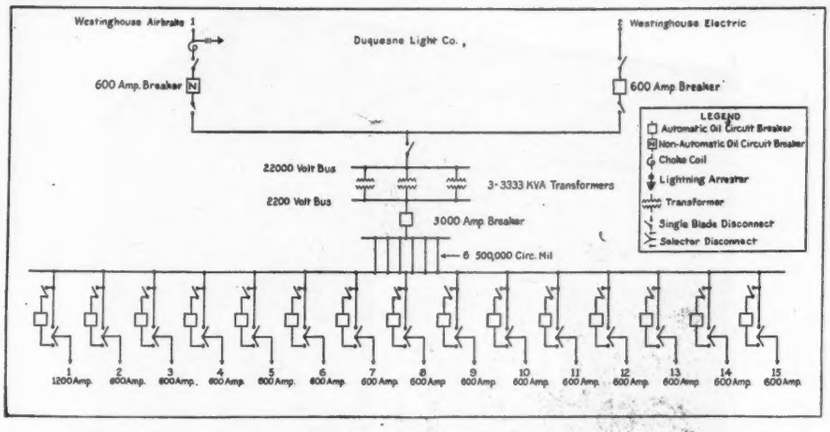


Fig. 3—Single-line wiring diagram of the high-tension and primary distribution systems.

mounted on the fence. One of these telephones is located at each of the six transformer banks, and they have paid for themselves many times over. By means of these magneto 'phones we can keep in touch with the substation, or I can communicate from my office through the substation with men working on the banks, as well as with the substation operator, both at the same time.

We clean our insulators and all other parts about four times a year and go over everything thoroughly, painting when necessary, twice a year. This practice keeps things in very good shape, and although it is expensive to work eight or ten men every week end, it has paid well, for we have had no failures.

Our cables are single-line feed, not loop feed, and for that reason we have gone to the use of 5,000-volt paper insulation and 3/32-in. lead sheath. These give us a greater factor of safety than we would otherwise need were it possible to feed in a loop.

In changing our secondaries we pulled in new feeders directly under the old ones, and as we rewound our two-phase motors and installed new, three-phase motors they were connected to the new lines over the week end. As the two-phase motors were rewound, they were put back in service on the old, two-phase lines which, by the way, supplied us with both two- and three-phase power. The latter was obtained by putting Scott-connected auto-transformers across the two-phase lines.

When we had completely changed over a department, the old lines were cut down and the motor leads tapped onto the new, three-phase circuit over the week end. This procedure eliminated production delays in the department involved in the change.

Our secondary feeders are all computed on the basis of 3 watts per square foot for general lighting and 1 watt per square foot for machine lights, portable tools and so on, which makes a total of 4 watts per square foot for lighting. The power cables

Fig. 2—What the distribution switching station looks like. Note the ample working room and the general accessibility of this installation.

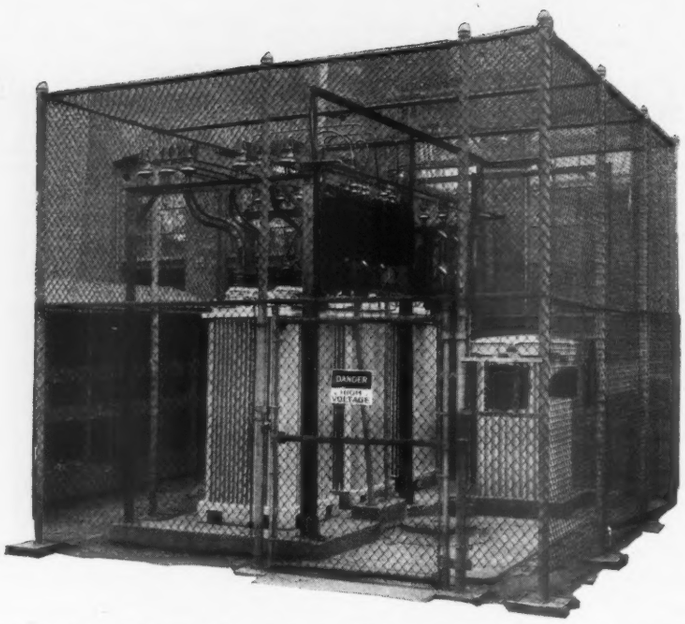


Fig. 4—A typical transformer bank with a capacity of 750 kva. for power service and 150 kva. for lighting, with a tap-off for an electric furnace.

are all figured on the basis of approximately 12 watts per square foot, which has worked out very well.

In changing over a system in the manner in which we did the job, there is one point that should be watched: that is the phase current on the two-phase system. It becomes very badly unbalanced when both two- and three-phase motors are operated on the same circuit. In fact, it will pay to have two separate ammeters that are in circuit at all times.

When we started to change over we hired twelve new wiremen and four more motor winders to handle the job. Now it is all done, the extra men are gone, and "all is quiet along the Potomac." But during the two years that were required for the changeover we not only rewound the existing 1,100 motors, but installed that many new ones. We now have installed about 2,300 motors ranging in size from ¼ to 1,427 hp., with their varied controls, 29 elevators, 39 cranes, 25 electric furnaces and pots of one kind or another, 19 electric trucks, and much other equipment, along with a lighting system that consumes about 1,600 kilo-watts.

Our repair shop has been completely rearranged, so that we get maximum production from the space allotted to us. Fig. 5 shows a corner of the motor winders' room, which adjoins the repair shop. We not only rewind all of our own motors, but make practically all of our coils, slot insulation, wedges, and so on. Unlike many other plants, we have a coil department that makes motor coils for the compressor motors that are part of our regular production.

Our electrical department organization chart is shown in Fig. 6. We have shifted men from one crew to another several times, until we now have one foreman, one assistant foreman, one draftsman, who also does special work, five motor inspectors, three oilers (for motors only), three crane repairmen, one telephone man, nine wiremen, two lamp cleaners, two night electricians, three substation operators, two motor winders, two clerks, and two helpers, one for the motor winders and one for general work.

One practice that we find very helpful in machine installation was started six years ago and involves the mounting of control switches along with the safety switch directly on the machine which they control, whenever this is possible. We make a practice of mounting on each building column, at the aisle, a 100-amp. safety switch which serves as a main cutout for that particular bay. From this switch we take off our lines to the individual machines which, as mentioned before, have their individ-

Fig. 5—A corner of the motor winders' room. The coil bins can be seen at the left. The "growler" for testing armatures is located just under the small switchboard in the background at the right. Note the circular steel frames in which small stators are mounted for rewinding.

ual safety switches and contactors mounted directly on them. When it becomes necessary to move a machine, as is often the case, all that is necessary is to disconnect the line at the machine safety switch, move it, and reconnect at the safety switch.

I am an advocate of line-start motors wherever it is possible to use them. Of course, we do not attempt to employ them on punchpresses and similar applications, but we do use them on nearly all standard machines, such as lathes, drillpresses, shapers, and the like, with very good results. We start everything up to 50-hp. rating across the line on 440 volts, whereas on the 2,300-volt service we have a new 300-hp. synchronous motor-generator set which starts across the line, and it is one of our smoothest-starting sets.

During the past two years we have paid particular attention to power factor correction, which we started by taking graphic charts on nearly every motor in the plant that was rated at more than 2 hp. This procedure not only allowed us to make changes in motors that would better our load conditions, but also gave us a very close check on all machines.

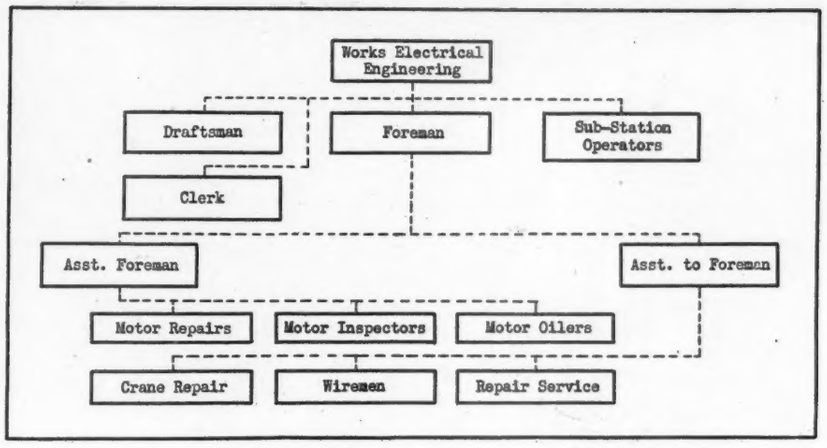


Fig. 6—Organization chart of the electrical department, which comprises a total of 38 men, including the works electrical engineer.

The results were tabulated and filed under the separate departments according to the machine, so that we now have a very good record for future drive data.

We are at present installing a 450-kva. bank of static condensers with which we expect to keep our power factor at nearly unity at all times, which, of course, will result in a slightly lower cost per kilowatt-hour.

We have learned three main points about installation and maintenance work which, if followed, will make for better conditions throughout the plant. These points are:

1. Put all work in with safety of operation the paramount thought.

2. Put all work in as though you expected it to be in operation when your grandchildren are grown.

3. Keep your equipment always up to date.

Good Plant Housekeeping

is essential to our business

By DR. M. A. DITTMAR

Assistant Factory Manager
Lehn & Fink, Inc.
Bloomfield, N. J.

Housekeeping, also, lends itself to modernization

CLEANLINESS, which is in effect merely another name for good plant housekeeping, costs money, of course, but there can be little question of its value in several different respects. In our plant the utmost cleanliness is so essential that it occupies a prominent place in our activities and among the ideals that we are striving to attain.

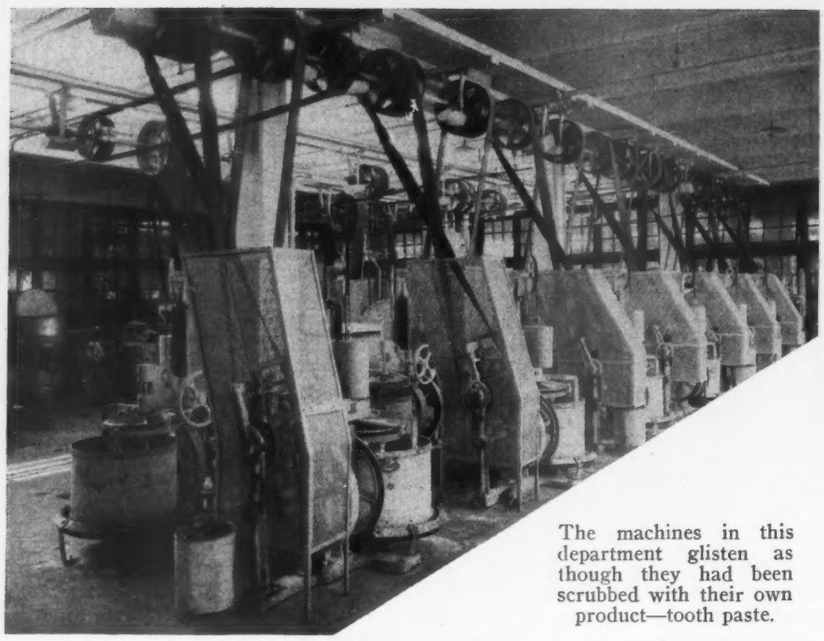
The reason for this attitude may become more clear from the statement that in our plant more than 200 pharmaceutical and cosmetic specialties are manufactured. In the production of these it is obvious that every precaution must be taken to prevent contamination with foreign matter. These products are made under rigid chemical control and must be held to the highest standards.

Aside from this, we are convinced that the cleanliness of the surroundings has a great deal to do with the morale and efficiency, as well as the health, of the employees in a plant. It may be possible to obtain efficient production of a high-grade product in a poorly-kept plant, but it is certainly more difficult to do so than in the case of one that is kept clean.

We have a good many acres of floor space which is divided into about twelve principal manufacturing departments, in addition to the offices, chemical, biological, bacteriological and photographic laboratories, stockrooms, shipping departments, machine, carpenter, blacksmith, pipe fitters' and other shops and departments.

The plant engineer is responsible for keeping the plant buildings and equipment clean and in the proper condition. His organization for this purpose consists of a maintenance foreman who has charge of all buildings and grounds. This man serves as gang boss of the cleaning department, which consists of a foreman and eleven employees.

The foreman of the cleaning de-



The machines in this department glisten as though they had been scrubbed with their own product—tooth paste.

partment is in charge of the daily routine cleaning and is responsible for the laundry, garments, and cleaning supplies. On his staff are:

One helper, who assists him for three hours daily with the cleaning and laundry distribution and then does the regular routine cleaning work.

One matron, who assists with the laundry distribution and supervises the girls' locker and washrooms and the hospital room.

One night cleaner, who is responsible for cleaning all men's and girls' washrooms.

One window cleaner, who does all of the regular window cleaning throughout the entire factory.

A group of five men for the heavy scrubbing, floor waxing and polishing.

A clean-up gang of two men for the thorough cleaning of all woodwork, window sills, lighting fixtures and the like, and who also do any necessary small jobs of painting, oiling and polishing.

To insure the most efficient performance of the work a manual of instructions has been prepared for the cleaning department. In this manual, which was based on a thorough study of our plant cleaning and allied problems, the duties of the principal members of the cleaning department are set forth in detail, with complete instructions as to how and when the cleaning operations are to be performed and the sanitary facilities cared for.

The functions of the cleaning department are outlined as follows:

1. Daily routine cleaning of offices and hallways.
2. Handling of factory laundry.
3. Furnishing cleaning supplies and rags to other departments.
4. Factory window cleaning.
5. Thorough scrubbing of office floors, departments and shops and waxing such floors as require this treatment.

The daily routine cleaning consists of sweeping and dusting the various offices and office stairs, downstairs hall (where the time card boards are kept), entrance lobbies and vaults. The cleaning department manual specifies how these duties shall be carried out.

The daily duties of the foreman's helper are: From 5:45 a. m. to 9 a. m. he assists the foreman in cleaning the offices. According to the manual, he is directed to, (*a*), dust office furniture and equipment, files, cabinets, wooden partitions, and other places where dust gathers; (*b*), sweep and dust girls' and men's locker rooms; (*c*), sweep halls and dust windowsills and wooden partitions in same; (*d*), sweep stairs in main and mill buildings and dust bannisters, windowsills and corners where needed; (*e*), take all cuspidors to the men's toilet where they are to be emptied; (*f*), clean and scour cuspidors thoroughly twice daily; (*g*), after the second lunch period, sweep the lunch room and dust all wooden partitions and windowsills; (*h*), wash all water fountains in the main and mill buildings.

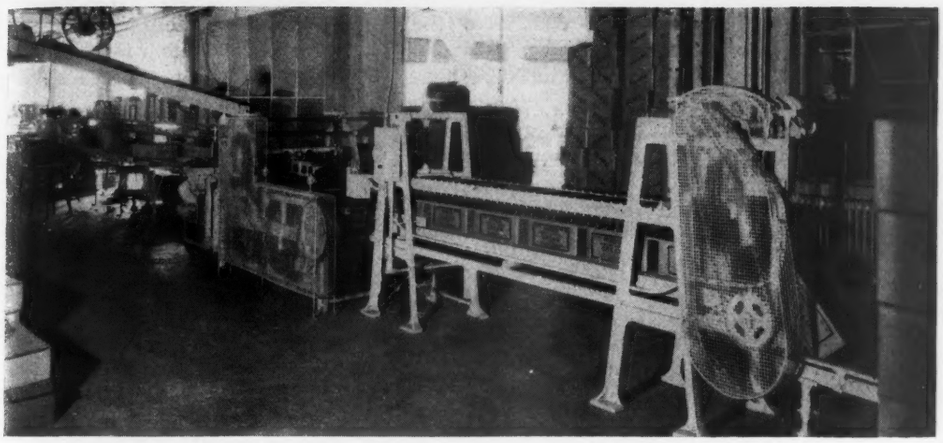
The weekly duties of the helper are:

Monday and Tuesday, assist the foreman in distributing and collecting the laundry.

Tuesday, wash all white-painted corners in the halls and on the stairs. A brush and soapy water is used for this cleaning.

Wednesday, sweep and dust the label room. In case a big shipment of labels is received, the gang boss of the cleaning department is notified

Hospital-like cleanliness surrounds every operation in the special face cream and lotion department. These are the tables on which the products are packed in cartons.



At the end of the journey through the packing machine in the hand lotion department. The packed cartons are then taken to the shipping department.

that additional dusting has to be done.

Thursday, wash the stair bannisters with soap and water and mop the girls' and men's locker rooms.

Friday, clean the supply closet under the main stairs.

For heavy cleaning, such as thorough scrubbing of floors anywhere in the buildings, a group of men is kept overtime, preferably on Saturday afternoon. This group consists of five men.

Cleaning of this kind is done whenever and wherever it is necessary, depending somewhat upon weather conditions. For scrubbing, waxing and polishing, an electric machine with detachable brushes for the various processes is used.

The men must first remove all furniture or other movable equipment to one side of the room. Then the place is swept and washed with soap water, using the electric scrubbing machine for this purpose.

For concrete floors, a steel brush is attached to the electric scrubbing machine, whereas a fiber brush is used on painted floors and linoleum.

For cleaning concrete floors, water mixed with soda, soft soap and a little disinfectant is used. For cleaning linoleum and painted floors, only soft soap and water and a little disinfectant are employed. For mopping up the water, the regular cleaning mops are used.

After one part of the floor has been cleaned, scraped and mopped, two men start waxing it with a liquid wax. The wax is spread on the floor with a rag by hand and polishing is done with the electric machine to which a bristle brush is attached. All floors covered with linoleum, as well as painted floors, must be waxed and polished.

When the men finish the work, the electric machine, brushes, mops, pails, and cleaning supplies, such as soap, soda, disinfectant and wax, are put back into the yard tool house, where they are kept until the next cleaning job. All equipment must be thoroughly cleaned before it is put away.

The cleaning of the chemical, biological and bacteriological laboratories, laboratory office, balance room and library, is handled separately by a woman porter.

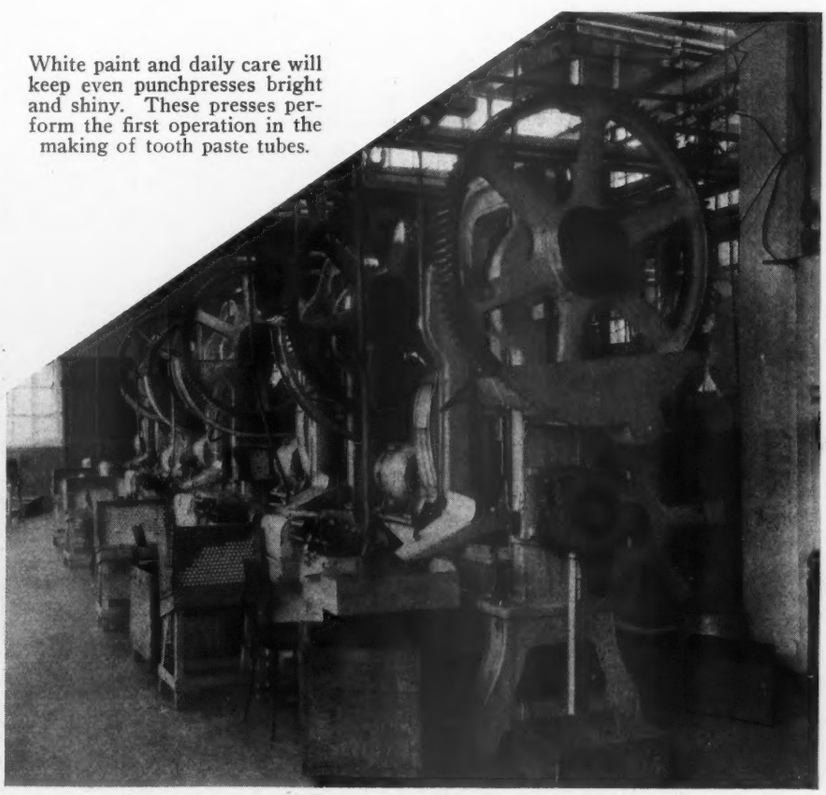
It is a general rule in our plant that in every department and shop each worker takes care of his own work place. This means that every worker who is in charge of a machine must dust it every day and oil it when necessary.

Routine cleaning of the various manufacturing departments and shops is in charge of the foreman of each department. One or more men are detailed to the work of removing all refuse, sweeping the floor and keeping the department clean at all times.

All office workers are required to keep their desks, chairs and other equipment, such as typewriters, adding machines and so on, clean by a daily dusting.

Daily cleaning of all men's and girls' washrooms is done by the night cleaner, whose hours are from 4 o'clock in the afternoon to 12 o'clock midnight. He cleans all wash basins, toilet basins and the floors, and fills the soap containers.

Window cleaning is taken care of by one man, who does the cleaning



White paint and daily care will keep even punchpresses bright and shiny. These presses perform the first operation in the making of tooth paste tubes.

of all windows throughout the entire plant. He receives orders from the gang boss regarding the departments or place in which cleaning of windows is to be done.

The clean-up gang of two men does the extra work, such as cleaning lighting fixtures, oiling and polishing woodwork and so on, that is not required to be done every day. A typical set of instructions for the guidance of these men is as follows:

Main Office

Dust all pipes suspended from the ceiling and on the walls.

Sweep and wash radiators between double windows (also the floor space under the radiators).

Sweep and wash windowsills.

Wash all lampshades, bulbs and bowls.

Dust and polish all woodwork.

Wash and polish all desks (top, front, sides and back).

Polish all steel furniture.

Wash off finger marks on posts and other light painted surfaces.

Clean all corners where vacuum cleaner does not reach. Use soap—then polish.

Do whatever small jobs of painting are needed.

Polish door knobs.

A similar set of instructions covers specifically the work to be done in all other offices and laboratories.

In all of the manufacturing departments and shops the work of the clean-up gang consists of cleaning ceilings, pipes and woodwork, lamp shades, bulbs and bowls, windowsills, radiators and chairs.

A simple order form is used by the gang boss in giving instructions to this cleaning gang. On this order sheet he enters the cleaning operations that are to be performed. A duplicate of the list is given to the cleaners for their guidance. On the following day the instruction sheet has to be returned to the gang boss, who inspects the work and makes sure that every part of it that has not been completed is finished the following day. After all of the work prescribed on the instruction sheet has been done, the original is sent to the main office, where it is filed. A duplicate is kept by the gang boss. The purpose of keeping these sheets showing the work completed is to satisfy any complaints that a certain department has not been cleaned within a given period.

The matron is in charge of the hospital room, which is well equipped for emergency work, and is responsible for taking care of it and keeping it in the proper condition. This includes cleaning the floor, sterilizing the medical equipment which is used by the doctor, keeping the necessary supply of medicines and accessories on hand and seeing that the medicine closet is clean and neat.

All persons reporting to the hospital room for minor injuries are attended by the matron. She makes an entry in her record book of each case attended and states the details thereof. In case an accident is of such nature that it must be reported to the insurance company, the matron renders a complete report of the case on a treatment report form provided for that purpose. One of these reports is sent to the main office and a duplicate is kept on file in the hospital. At 4 o'clock every day the matron assists the visiting doctor in taking care of patients reporting to the hospital room.

Locker Rooms Kept Closed

The matron also acts as monitor in the girls' locker and wash rooms. On her arrival in the morning, it is her duty to ventilate these rooms and see that toilet paper and soap are provided. The locker rooms are kept closed from 8:30 a. m. until 11:55 a. m. and again from 12:30 p. m. to 4:30 p. m., when the girls begin to quit work. When a girl is compelled to leave the plant during working hours or when one of them wishes to get something from her locker, it is the duty of the matron to accompany her to open and close the locker room.

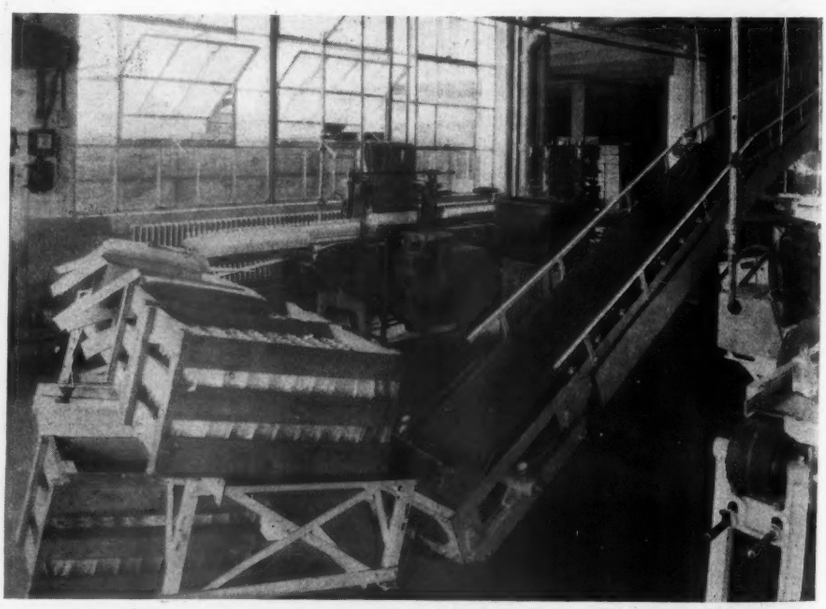
Every Monday and Tuesday it is the duty of the matron to assist the foreman of the cleaning department in the distribution and collection of the laundry. She is also responsible for keeping three candy vending machines located in different parts of the plant filled with candy, and collecting and turning over to the main office the money from them.

Machinists' coats (gray) and overalls and aprons of white material are supplied to workers in the various production and packing departments. Two of each garment, coat, apron or overall, are furnished to each person, so that while one is in use the other is in the laundry.

When issued to employees, overalls and coats are marked with indelible marking ink with the employee's name and department and the date issued, on the inside of the garment where it can easily be seen when the garments are being distributed upon their return from the laundry. Aprons are numbered and marked with a code number, indicating the department to which they are issued.

Laundry on Weekly Basis

About 2,300 towels and 260 other pieces of laundry are handled weekly by the cleaning department foreman, who is assisted in the distribution and collection of towels and garments by his helper and the matron. Every



A bottle-filling machine in the hand lotion department. The small belt conveyor at the right carries empty cartons to the packaging machine.

Monday all towels that are furnished to employees are collected to be sent to the laundry, and every person receives a clean towel in exchange.

Every Monday the matron and the cleaning department foreman's helper distribute clean garments, which have been sorted by the foreman according to the department receiving them. A slip is attached to each garment showing the name of the employee to whom the garment or garments are to be given.

On Tuesday all soiled garments are collected by the helper and the matron from the department which received clean garments the day before. When collecting the soiled garments, the helper and the matron enter on a slip of paper the name of the employee, kind of garment, and quantity.

After collection, all soiled towels and garments are sorted and tied into bundles containing a certain number of pieces and made ready for delivery to the laundry.

The cleaning department foreman is responsible for keeping an accurate record, on a form provided for that purpose, of the exact number of towels and the number and kind of each garment collected from the various departments and the total number of pieces delivered to the laundry. When clean garments and towels are delivered, he checks them over to make sure that the proper number have been received. The completed laundry record is then sent to the office, where the figures are entered on our books and is then returned to the foreman of the cleaning department.

Paint Is Important

The importance of soap and water cleanliness, from our standpoint, has already been discussed. However, it cannot successfully take the place of good paint. Hence, the hissing of the spraying machine and the flap-flap of paint brushes are always to be heard in our plant. We keep a gang of painters busy all of the time, with the result that practically every department in the entire plant is painted once a year. Most of our machines are likewise painted every year.

We use a flat white paint on all walls and ceilings. Recently we have adopted the use of aluminum paint for the dado and are pleased with the result. Aluminum paint is also being used in a number of other places, and we feel that it is going to work out very satisfactorily. It has good covering powers, stands up well, and diffuses light well, while it is at the same time less glaring than white paint.

Concerning Junked, Used and Rebuilt Machinery

By GEORGE RICE

MANAGERS of plants in which machinery is employed, who would not think of buying an automobile from the junk pile, have been known to buy junked machinery for their establishments. Just why some superintendents and machinery buyers think that a producing machine should maintain its full efficiency after running eight hours a day for a dozen or more years, when their automobiles, which perhaps are run but two or three hours a day, are supposed to be worn out, lacking in style and devoid of class in two or three years, is almost beyond understanding.

Very few persons will go to the graveyard of any automobile wrecking concern to buy a car, yet machinery which has been discarded by others has been salvaged by unthinking men from scrap heaps and put to use after considerable repair work and, as a rule, operated at an economic loss.

Machinery of almost any kind which has been put on the market by a bankrupt concern has a chance of being all right, since it is for sale because there is no further use for it and not necessarily because it is worn. Often machinery which is placed on the market by large manufacturing industries which are substituting new models is a good buy. Manufacturing plants occasionally change from one line of products to another and the machinery which answered the purpose for the one line has to be displaced by machinery suitable for the manufacture of the new line.

Rebuilt Machinery Good

Machinery which has passed through the rehabilitating departments of the modern rebuilding shops usually is about as good as new so far as running conditions are concerned. Machinery which was made in 1919 cannot be rebuilt exactly into a 1929 machine, but with the efficiency of workmanship and equipment of most secondhand machinery dealers, it is possible to make a 1919 machine almost like it was when new at that time.

The title "second-hand" is against such machinery, no matter how well it has been rebuilt. Second-hand dealers in automobiles and house furnishing goods use the phrases "used cars" or "used furniture." People who would not ride in a second-hand car will ride in a used car. Second-hand machinery is called used machinery in some sections of the country and with advantages to the sales distribution.

Sometimes because of lack of ready cash, or because he is just starting in business, a man has to buy machinery from a second-hand dealer, for then his capital will go further. If he visits the rebuilding shops of a dealer he will see that every detail of mechanical motions of every machine is inspected, tested and reconstructed if necessary.

Beginning Business With Used Machinery

Of course it is always best to buy new machinery direct from the builders. But there are thousands of industrial plants in the country which never could have started if they had not been able to procure equipment from second-hand dealers at the lower prices. Once they got a good start with second-hand machinery they were able gradually to install new machinery direct from the builders. "Junk" machinery, however, is a poor buy, as many men have discovered.

Conference Recommends Wire Rope Research to Continue

RESOLUTIONS were adopted to continue the research on wire rope by the representatives of the many fields of users at the Third Wire Rope Conference held Sept. 13, in the Engineering Societies Building, New York City. This action is a result of the discussion from a series of twelve papers, which pointed out the use and abuse wire rope receives and the problems that press for solution.

A co-operative research committee is to be organized under the auspices of the Engineering Foundation and the American Society of Mechanical Engineers, and with the assistance of other interested technical organizations to make a study of the factors affecting wire rope life. The research program adopted is to be developed according to the present research procedure of the A. S. M. E.

MODERNIZING OLD MOTOR WINDINGS

In this article, which is the seventh of a series, the author tells how the old combined diamond and involute winding can be changed to the two-layer type

By A. C. ROE

Renewal Parts Engineering Department
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

THE obsolete windings that have been described in previous issues were fairly common types during the period that they were in use. The winding described in this article has a coil that combines the diamond and involute types of end winding, and due to its complicated construction comparatively few machines were wound with this type of coil. However, when a machine having a winding of the type discussed here starts to give trouble due to short-circuited turns, grounds, or other defects, it is advisable to strip the old winding out completely and install a new set of the up-to-date, two-layer type of coils.

The reason for this suggestion is based on the fact that the original molds used in winding the coils are, in the majority of cases, out of existence and would be expensive to replace, as will be obvious from the following description of the coils.

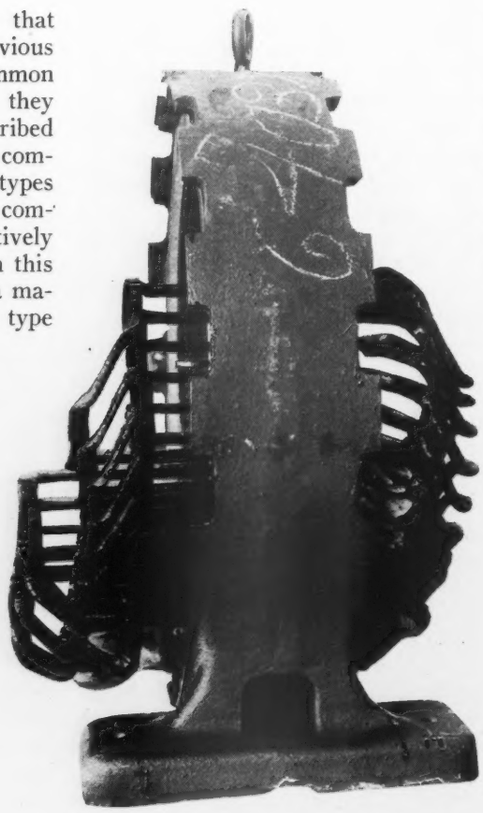


Fig. 1—Combined diamond and involute, three-layer end winding, one-coil-per-slot winding.

Some conception of the excess copper required for these coils may be obtained from Fig. 1, which also shows the generally complicated appearance of a combined diamond and involute, three-layer end winding, one-coil per-slot winding.

The combined diamond and involute type of coil is shown in Fig. 2. Note the number of sharp bends, which for the coil shown results in eight edgewise bends of 5/64x1-in. copper strap, and ten flat bends per turn, or a total of 54 bends per coil. The upper or top slot section and sides of the coil form practically three sides of a square, and extend the winding a considerable distance on both sides of the core.

The major dimensions of the coil given in Fig. 3 are for the coil shown in Fig. 2. It was designed for a 75-hp., four-pole, three-phase, 25-cycle, 200-400 volt, 750-r.p.m. motor having 120 slots and 60 coils, each coil consisting of three turns of one 5/64x1-in. bare copper strap. Note that the length of the top slot section is 14⅞ in. and the length of the bottom cell is 12¼ inches.

The coil pitch is 1-and-28, or two slots under full pitch. This long pitch was the reason for using this type of coil, as a full involute coil end would drop down too far, and the full diamond coil extend out too far.

Although this type of winding is difficult to change over, the results gained are well worth the trouble. The following example will indicate what can be accomplished.

In the old winding mentioned above there were 60 three-turn coils, or 20 coils and 60 turns per phase. Each coil required about 22¼ ft. of copper, or a total of 450 ft. per phase. In changing this winding over a three-turn coil would also be used. Thus, there would be six turns per slot, instead of three. The copper in the new coil would be 5/64 in. wide by ½ in. deep. This makes the cross-section of the coil 15/64 in. wide by ½ in. deep, which is suitable for double-cotton-covered ribbon wire wound flat. Or, the new coil could be wound with three turns of two .114x.168-in. d.c.c. ribbon wires in parallel.

The coil pitch could be reduced to 1-and-27, and the slot sections changed to 10¼ in. and 9¾ in. Then the total length of copper per coil would be about 28 ft., or with 120

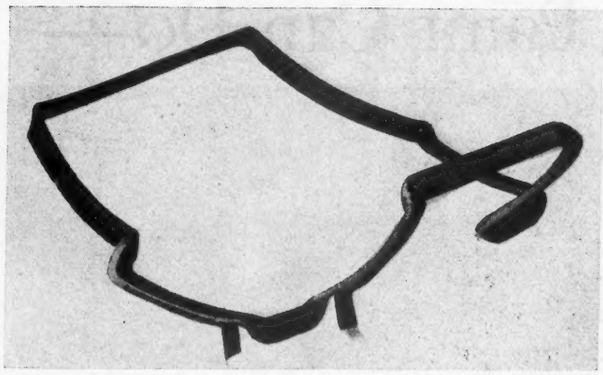


Fig. 2—Combined diamond and involute type of coil used in the winding shown in Fig. 1 above.

coils and 40 coils per phase there would be a total of 1,120 ft. per phase. The old winding had 60 turns per phase; then the new winding would have 40x3=120 turns per phase, requiring the use of a parallel connection and two ribbon wires in parallel, which cuts the number of feet of copper in series to 280 ft. per phase.

Thus the copper weight and I^2R losses will be reduced, as the total length of copper has been changed from 1,350 ft. of 5/64x1-in. strap to 3,360 ft. of .114x.168-in. d.c.c. ribbon; it is obvious that the 3,360-ft. length of ribbon is lighter than 1,350 ft. of bare copper strap.

In other words, the 1,350 ft. of 5/64x1-in. bare copper strap used in the old winding would be equivalent to 5,400 ft. of the ribbon used in the new winding. But inasmuch as only 3,360 ft. of ribbon are used there is a saving of 5,400—3,360=2,040 ft. of .114x.168-in. copper, or 2,040÷4 =508 ft. of the 5/64x1-in. strap originally used. This represents a saving of 37.6 per cent in copper.

A two-layer diamond type of coil would cost less than the original coil, as less material and labor would be required. There would also be some saving in time and material when installing and connecting the new winding. It would also be more efficient, as the power losses per year would be less, due to less copper, and stranding of the conductors would reduce eddy current losses. Thus the new winding would practically pay for itself in a short time.

First International Heating and Ventilating Exposition

IN exhibition form the pioneering and the present-day record of the heating and ventilating industry's activities and progress will be held in the Commercial Museum, Philadelphia, Pa., Jan. 27-31, 1930, in conjunction with the 36th annual meeting of the American Society of Heating and Ventilating Engineers.

Exhibits beneficial alike to heating and ventilating engineers, architects, building owners and managers, plant engineers, and those allied with the building industry will be shown.

Products on exhibition will include practically every type used in heating and ventilating; the boilers and furnaces in which combustion takes place; equipment using air, water or other heated liquids for the transfer of heat; systems used to distribute the heat, and radiators for diffusing it. This range of equipment will include that which is used in the industrial plant such as refractories, insulating materials, blowers, fans, air-conditioning and humidifying equipment, pipe and piping systems, pipe fittings, unit heaters and all the control and regulating apparatus and instruments used in the generation of heat, cooling and ventilating.

Fig. 3—Major dimensions and details of the bends in the combined diamond and involute type of coil.

What Paint Can Do—

and

NEW EQUIPMENT

For Plant Operation and Maintenance

Industrial plant executives concerned with the selection and operation of mechanical and electrical equipment will be interested in these new devices which are designed to improve plant operation or reduce operating and maintenance costs.

Trumbull Electric "Flex-A-Power"

EXTREME flexibility and low maintenance are emphasized by the Trumbull Electric Manufacturing Company, Plainville, Conn., in introducing "Flex-A-Power," a convenience outlet for power distribution in industry.

It is a mobile system of unit lengths adaptable without alteration to any plant and especially those where production requirements necessitate the frequent shifting or replacement of machinery. Standard lengths are joined to form any desirable plan for power distribution regardless of the peculiarities of existing conditions, since it provides complete distribution of power from the secondary power source to the last motor in the plant. It is equally applicable, it is stated, to storage battery truck charging, electrical welding distribution, vertical and horizontal methods of construction and many other uses. Bus bars are used entirely in this system, eliminating wires, rigid conduits and power panels. Unit construction provides for ease of installation, re-arrangement of runs in any direction and extension or reduction of feeders. Units can also be transferred from one plant to another.

Flex-A-Power consists of a steel housing provided with installation end supports and lined with an insulating material having barriers and bus supports to insulate and protect the bus bars. The housing, 8 ft. in length, is formed from 10-gage steel into a section 8 in. wide and 4 in. deep, and riveted to the back are two 2x¼-in. flat-iron supporting straps with mounting holes projecting beyond the edge of the trough.

This trough is lined with impregnated asbestos lumber and it is also equipped with two inner barriers of the same material, thus allowing three separate and distinct bus-bar spaces, rectangular in cross section. Bus-bar supports are placed at convenient intervals in these three spaces. These supports are ebony cleats, slotted to accommodate rectangular bus bar.

The bus sections are slightly longer than the channel and both ends of the copper bus are punched to allow for bolting adjacent sections together. The busses are also free to slide in their supports, a feature that makes assembly easy without removing the cover plates. The cover plates, like the lining and barriers, are made of impregnated asbestos lumber.

Special cast copper contacts are riveted along these copper bars at 2-ft. intervals. These contacts consist of two roller members encased in copper and held in contact with each other by heavy steel springs. By putting one set of contacts on each bus bar, at the same point in the raceway, a three-phase tapping joint is obtained, and to make this connection available for use, holes are provided in the bottom cover plate directly opposite the roller points. Polarization is obtained by off-setting the contacts so that the distances between adjacent contacts is varied.

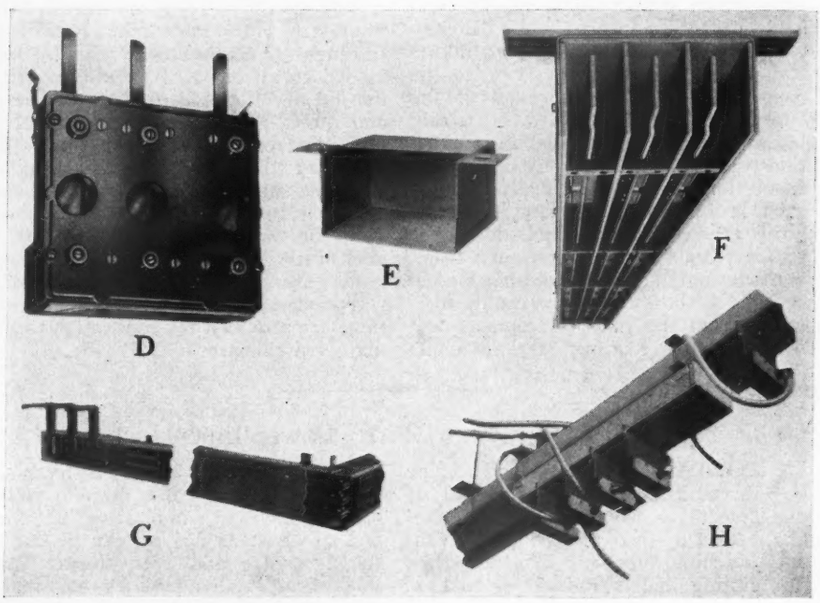


Fig. 2—Elements of Flex-A-Power System. (D) Flex-A-Plug. (E) End box. (F) End view of Flex-A-Power. (G) Section of Buss-Wa. (H) Flex-Adapters

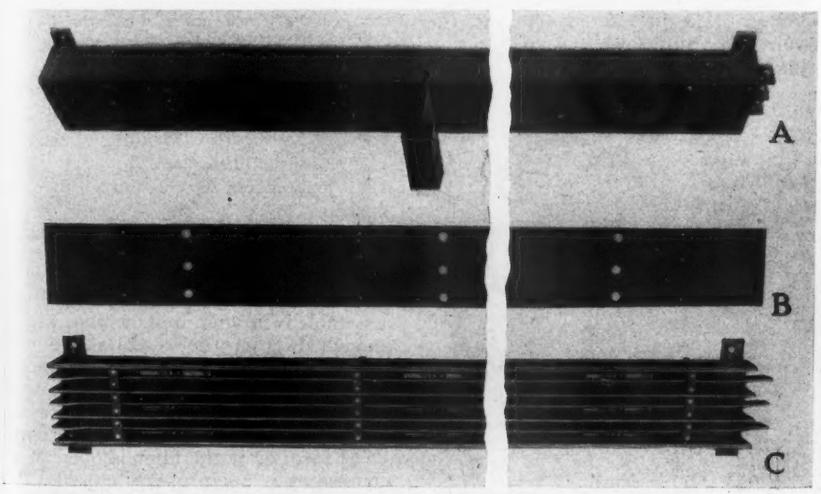


Fig. 1—Elements of Flex-A-Power System. (A) 8-ft. section with Flex-A-Plug. (C) Section with bottom cover (B) removed

MAINS, BRANCH TAPS AND CONNECTIONS TO MACHINES

The only connections necessary to the individual motors are those from the "Flex-A-Plug," which consists of a non-breakable molded bakelite cloth

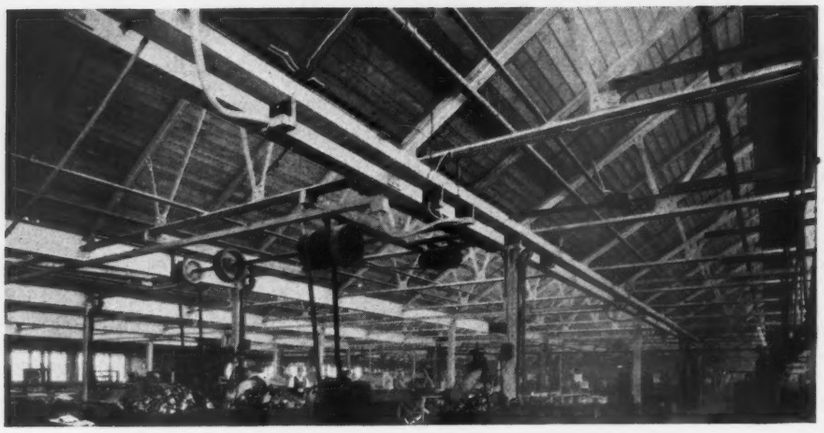


Fig. 3—An application of Flex-A-Power with Flex-A-Power, Jr., a branch power system for smaller current capacity

housing and cover plate having three extension prongs. When the plug is injected into the raceway, at the points provided in the cover plate, these prongs are arranged to mesh in the rollers on the bus bar. The prongs are hard-drawn copper bars, molded and held in place by inserts in the bakelite. One end of a standard fuse link is clamped by means of a screw to the copper prongs; the other end of the fuse link is clamped to a wiring terminal which is inclosed in a junction-type compartment of the plug. Inspection glasses are furnished over each fuse link and the clamping screw heads are recessed to permit the use of test devices for locating faulty fuses, without making the screw heads susceptible to short circuiting and grounding. From the junction compartment of the plug, flexible steel conduits are led to non-fusible disconnecting switches on the motor or machine.

Additional outlets are possible with "Flex-Adapters," which are assentially short sections of Flex-A-Power except that contact receptacles are more closely spaced. They are inserted in the system in the same manner as Flex-A-Plugs. Flex-A-Power may be extended to all parts of a building with the aid of "Flex-Ells," "Flex-A-Tees," and "Flex-A-Crosses," and to other buildings or transformer banks by means of "Buss-Wa," which is similar in construction to Flex-A-Power and intended to be used as a main feed from the switchboard to Flex-A-Power and "Flex-A-Power, Jr.," branch systems. Buss-Wa has no branch outlet receptacles. Bus or lug-terminals sections are provided for connection to the main switchboard.

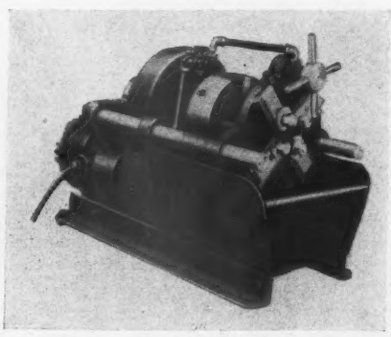
Toledo No. 999 (½- to 2-in.) Power Pipe Machine

A PORTABLE, power-driven pipe threading machine designated as the Toledo No. 999, has been placed on the market by the Toledo Pipe Threading Machine Company, Toledo, Ohio, for cutting and threading ½- to 2-in. diameter pipe.

It is light enough to be readily carried by two men; net weight of stripped machine for carrying is 265 lb. It occupies a space 32x16 in. on a bench and is only 20 in. high. Regular equipment consists of the complete machine, 6 die heads with ½- to 2-in. right-hand dies, bushings, complete set of 4 cutter blades, chuck wrench, cutter blade wrench, friction gear wrench, 10 ft. of cable with connectors and one gallon of thread cutting oil.

Power is transmitted from a ½-h.p. 110-volt universal type motor through direct gear drives. The entire mechanism is protected by a safety friction gear, which slips in the event of overload. The power transmitted through the safety friction gear can be easily regulated by tightening or loosening six cap screws.

The cutting head is of special design, equipped with four circular cutter blades which cut simultaneously. Nipples as short as 3¼ in. can be cut in the 2-in. size and even shorter than this on the smaller sizes; ½-in. nipples as short as 1¾ in. A centrifugal pump is built into the machine and is directly driven from the motor. The oil reservoir and all oil lines are easily accessible for cleaning.



Toledo No. 999, ½- to 2-in. power pipe machine

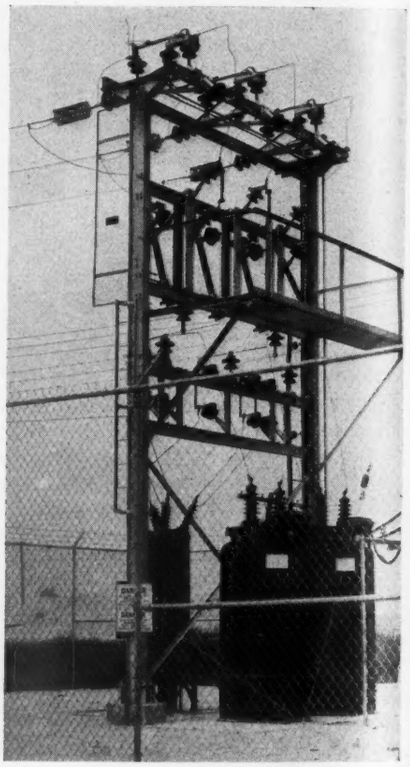
Delta-Star Industrial Substation

AN outdoor substation serving industrial plants from transmission lines is being marketed by the Delta-Star Electric Company, Chicago, Ill. High-tension service is brought in from a gang-operated, three-pole, vertical-break switch mounted on the top of the structure, the switches being controlled from ground level.

Metering is done on the high-tension side, the station being provided with disconnecting switches having by-pass blades.

These stations are made for all commercial voltages and a wide range of transformer capacities.

The installation illustrated is connected to a 26,400-volt transmission system.

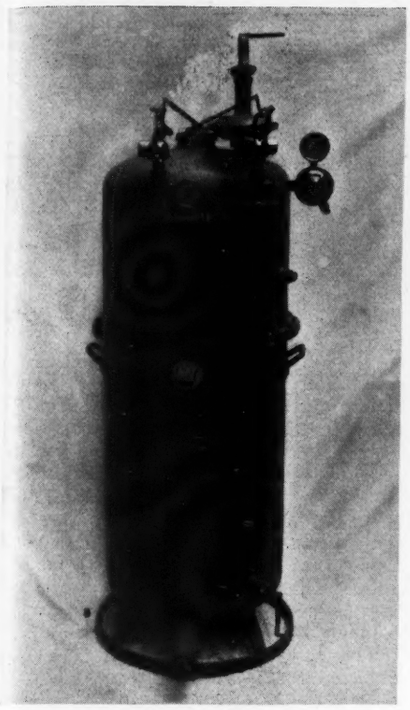


Delta-Star Industrial Substation

Milburn Acetylene Generator

THERE has been placed on the market by the Alexander Milburn Company, Baltimore, Md., a portable acetylene generator for welding and cutting.

According to the manufacturer, the generator has no clocks or motors and notably few moving parts. Carbide hopper feed control and head are assembled in one unit which can be detached from the seamless body by the removal of a few bolts. The carbide feed is controlled by a single valve which responds to high or low pressure and automatically stops if the pressure is at zero, or if the filler is open or the generator is not properly closed.



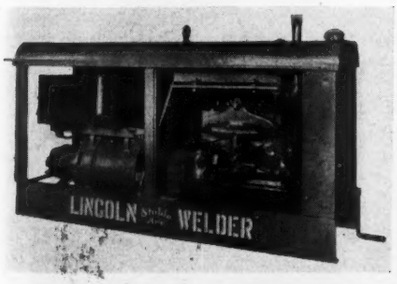
Milburn Portable Acetylene Generator

The machine is equipped with blow-off valves, pressure control, safety gas purifier, and strainer. The component parts of the machine are made with over-size outlets all welded into the seamless steel body of the generator.

The body has a protective coating inside and out. Handles of ample size, welded on to the body, provide for convenient transportation. The generator is made in three sizes; 35-, 70- and 100-lb. capacities.

Lincoln Gas-Engine-Driven Welder

A GAS-ENGINE-DRIVEN welder for use where electric power is not available has been introduced by the Lincoln Electric Company, Cleveland, Ohio. The welder is of 200-amp. N. E.



Lincoln Gas-Engine-Driven Welder

M. A. rating and is powered by a 4-cylinder Waukesha engine, operating at 1,500 revolutions per minute.

The improvements which are featured in the improved models of Lincoln gas-engine-driven welders are included in this model. An automatic idling device is incorporated which automatically reduces the speed of the gas engine when welding operations cease and automatically accelerates the engine to proper speed as soon as welding is started. It is stated that this automatic idling device will reduce fuel consumption as well as wear in the welder, which will permit longer life of the equipment.

Another feature of this welder is the complete protection afforded the machinery by the welded steel canopy which totally incloses the outfit.

Unified control, a feature of all improved "Stable-Arc" Welders, is also incorporated in this model. Operating controls are inclosed in a ventilated steel cabinet.

G. E. Magnetic Switch with Oil-Immersed Contacts

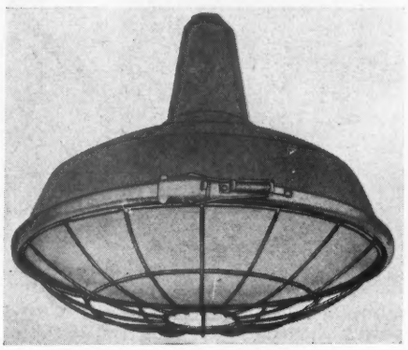
THE General Electric Company, Schenectady, N. Y., announces the development of an oil-immersed magnetic switch of small capacity, designated as CR-7006-V-7, which is claimed to be particularly suitable for use in gaseous atmosphere or in locations where highly corrosive gases or acids are encountered.

This switch has a capacity of 40 amp. and can be used with any motor, from 110 to 600 volts, the full-load current of which does not exceed this value. The contactor and interlock are standard in design. The overload relay used has oil-immersed contact tips in which the heaters are located above the oil level. The relay is reset from the top of the oil tank.

Benjamin Dust-Tight Cover Guard

A WIRE guard to protect the glass disk of Benjamin dust-tight covers against damage and breakage is now in production at the Benjamin Electric Manufacturing Company's plant, Des Plaines, Illinois.

The guard is made of heavy-gage steel wire with each joint tinned to prevent corrosion. The spring clamp on the retaining band of the dust-tight cover is released and the four steel lugs welded to the guard rim are inserted under the band. The spring clamp is then snapped into closed position.



Guard and dust-tight cover attached to a Benjamin RLM Dome Reflector

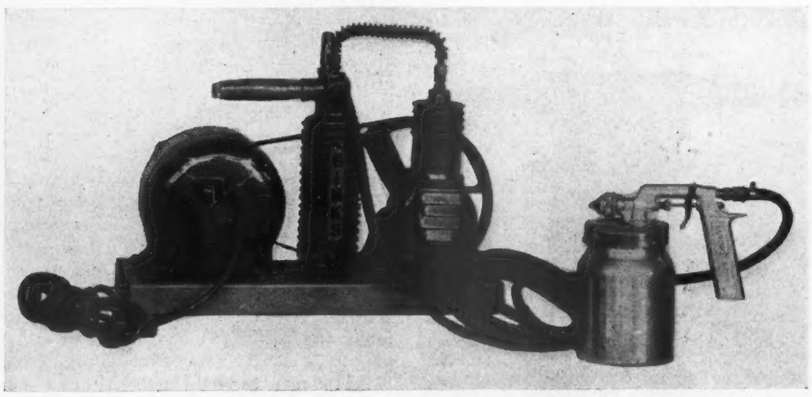
Combinations of the dust-tight cover and wire guard, when applied to Benjamin one-piece reflector-socket units, meet the requirements of the National Electrical Code for dust-hazardous locations, it is claimed.

Binks, "Hurley" Spray-Painting Unit

AN all-purpose, spray-painting and finishing outfit has been introduced by the Binks Manufacturing Company, 3114 Carroll Ave., Chicago, Ill. This outfit is being manufactured for general utility work, such as touching up, refinishing, repainting, and lacquering. It is also adapted for the spraying of insecticides and disinfectants.

It is a complete unit equipped with a quart size all-metal container and a Binks pressure-cup spray gun supplying an atomized flat spray four inches in width. The air compressor unit is belt driven from a ¼-hp. G.E. motor and has a capacity of 2.16 cubic feet of air per minute.

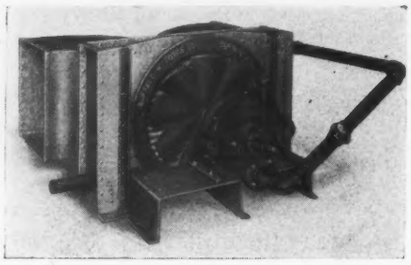
A ribbed, cast-iron air container is mounted between the motor and the compressor on a pressed-metal base, all of which is mounted on rubber feet. Ten feet of rubber-covered electric cord, attachment plug, and ten feet of air hose are standard accessories.



Binks, Hurley Spray-Painting Unit

Murray Steam-Turbine for Unit Heater Blower

A SMALL steam turbine for use with unit heaters has been introduced by the Murray Iron Works Company, Burlington, Iowa. The turbine, shown in the accompanying illustration, ex-



Murray Steam-Turbine Drive for Unit Heater Blower

hausts the steam directly to the heating coils, cutting the cost of the motive power needed for the fan considerably, says the manufacturer.

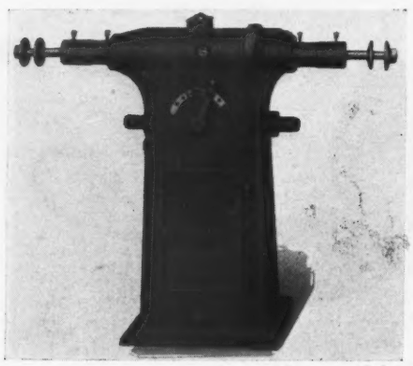
The turbine is generally so arranged that it will consume for power about two-thirds of the steam required for the heating element and the remaining one-third of steam is by-passed through the turbine by means of a valve provided for this purpose.

A separate speed control valve is also provided on the turbine.

U. S. Multispeed Buffer and Polisher

A BUFFER with a variable speed range for all polishing and burnishing jobs, known as the "U. S. Multispeed Buffer and Polisher" has been introduced by the United States Electrical Tool Company, Cincinnati, Ohio. The buffer is furnished in 4 sizes, 1, 2, 3 and 5 hp. for use on 220-, 440-, and 550-volt, two- or three-phase, 25-, 40-, 50- and 60-cycle a.c. service.

The method of transmitting power at the different speeds is done by means of a Gibbs V-disk transmission of graphitized micarta. A cone or series of different sized disks revolve on the motor spindle. Any one of these (depending on the speed desired) can be inserted quickly into a stationary, metal V-disk or sheave mounted on the wheel spindle by releasing the cone (by means of a foot pedal) and moving it into desired position (by means of a lever and speed positions indicated on the front of the machine). The motor and disk cone are mounted on a rocker arm so that they may be moved along the mounting parallel with the wheel spindle. Changes in speed are made only when the motor and wheels are not in motion. These buffers provide a range of four speeds from 2,000 to 3,000 r.p.m., but additional speeds can be added if desired.



U. S. Multispeed Buffer and Polisher

The wheel spindle is of heavy chrome manganese steel supported on 4 heavy-duty SKF ball bearings. The bearings are inclosed by a labyrinth seal in dust-tight grease compartments. The motor is built for continuous service of 40-deg. C. rating, with momentary overload capacity and operates at a speed of 3,600 r.p.m. A push-button control is mounted on top within easy reach of the operator. This control has overload protection and no-voltage release.

Westinghouse Develops Konel

DEVELOPMENT of a metal known as "Konel," which is credited with being much stronger than other metals at high temperatures and which can be used extensively in the moving parts of internal combustion engines and other extremely hot places, has been announced by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. The announcement followed the granting of foreign patent rights.

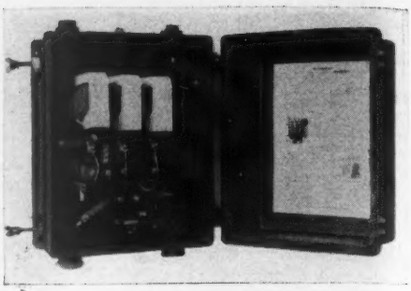
Originally developed by the Westinghouse Research Laboratories as a substitute for platinum in the manufacture of filaments for radio tubes, this metal was discovered to be harder to forge than steel, and to be very tough at high temperatures, when most metals lose their strength.

Westinghouse Dust-Tight Linestarter

WESTINGHOUSE Electric and Manufacturing Company, East Pittsburgh, Pa., announces the development of dust-tight and weather-proof linestarters. They are remote controlled, non-reversing, across-the-line type magnetic starters for single-phase and polyphase squirrel-cage induction motors. These starters are especially adaptable for use in coke plants, cement mills, steel mills, and other places where a dust-tight starter is very desirable.

Several features have been added to the standard line. It differs from the other types in its cabinet construction in that a cast-iron cabinet is used with a gasket seal on the door. The conduit is brought in through the top and bottom in threaded openings so as to make a dust-tight connection. These features make the cabinet dust-proof and water proof.

All dust-tight linestarters are equipped with the Deion grid-type arc quencher. It not only provides for protection against flashovers under severe operating conditions, but also increases the life of the contacts.



Westinghouse Class 11-200-B3 Dust-Tight Linestarter

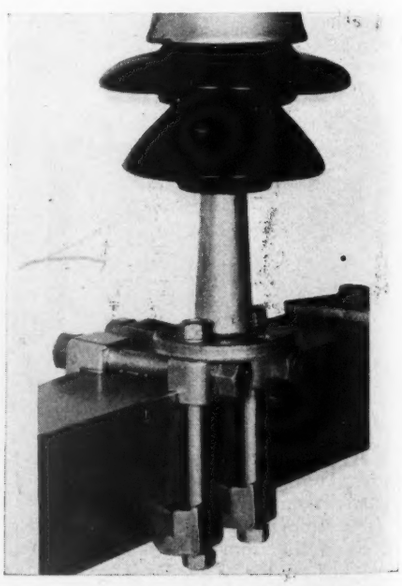
To prevent the operator from breaking the seal whenever the motor is put back in service after an overload, the two small size linestarters are equipped with an automatic reset thermal overload relay. This relay has interchangeable heaters, an accessible calibration lever, and quick make-and-break contacts.

The dust-tight linestarter is now available in three sizes up to 50 horsepower.

G. E. Beam Clamps

AN improved and complete line of beam clamps for either indoor or outdoor substations has been developed by the General Electric Company, Schenectady, N. Y. They permit the changing of existing installations to accommodate new apparatus without the need of drilling the structural steel members.

These beam clamps are commonly used to fasten ladder steps to outdoor stations, for mounting outdoor insulators and switching equipment, as well as forming a quick and effective method of attaching one steel member to another. They consist of hot-dip galvanized malleable-iron castings and necessary bolts and nuts.



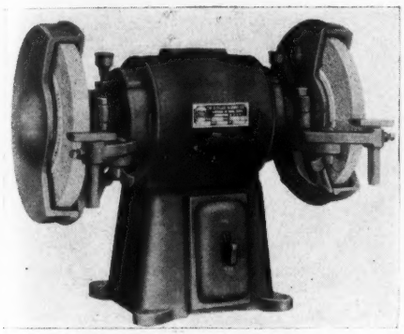
General Electric Beam Clamps

Schauer Bench Grinder

AN improved 1-hp. bench grinder for use on either alternating or direct current, and which is adaptable for general shop use, has been introduced by The Schauer Machine Company, Cincinnati, Ohio, manufacturers of "IDEAL" portable electric tools.

According to the announcement, it is mounted on an improved base which contains the safety-type toggle switch for quick make or break contact. The motor is totally inclosed for use in either wet or dry grinding.

Wheels are inclosed by means of end guards, and the tool rests are so mounted on the wheel guard as to be readily adjustable for any grinding position. End bells give maximum working space between motor housing and wheel. Solid-race, double-row ball



Schauer Bench Grinder

bearings are used, one at each end of the shaft. They are grease lubricated and dust proof.

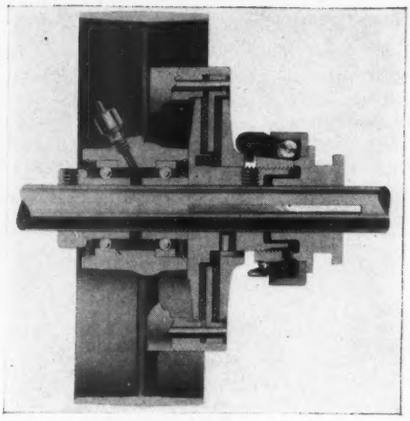
The height from the base of the grinder to the center of wheel is 11 in. Wheels, 10x1 in., are used, running at 2,000 r.p.m. on direct current, and 1,750 r.p.m. on alternating current. The weight is 162 pounds.

Edgemont "SF" Disk Clutch

THE SF disk clutch recently brought out by the Edgemont Machine Company, Dayton, Ohio, is provided with a single adjustment which can be manipulated by one hand without the use of tools.

The clutch is intended for a variety of applications ranging from countershaft installations to machine applications where either low or high speeds are transmitted. It is capable of picking up the load either slowly or quickly. The mechanism is provided in a complete line of pulleys with either oil-sleeve bearings, Timken tapered roller bearings, or Fafnir transmission ball bearings, and also in cut-off couplings. The clutches are also made with extended sleeves on which pulleys, sheaves, gears, etc., can be mounted. The mechanisms alone can be furnished to those who desire to make their own mountings.

Renewable asbestos metallic liners of



Edgemont High-Speed Disk Clutch

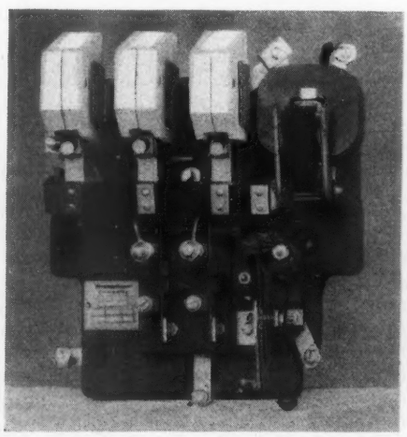
large friction area are employed. According to the announcement, the clutch is so designed that it is impossible for centrifugal force to cause it to engage or to drag at any speed. Levers exert pressure on the plate without any sliding action. The rollers are mounted in long levers to provide easy operation so that the driven member of a machine can be "inched" along.

Westinghouse Linestarter Without a Cabinet

IN some machinery applications, where it is desirable to mount the starter within the machine, the cabinet is not required. For such services the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., supplies the improved linestarter without a cabinet in three sizes covering a range up to 50 horsepower.

Like the other linestarters, this unit is also equipped with the Deion arc quencher and the thermal overload relay.

The Deion arc quencher provides protection from flashovers under severe operating conditions and, it is stated, increases the life of the contacts. Because the arc is completely restricted within the arc quencher, the over-all



Westinghouse Linestarter Without Cabinet

size of the starter has been decreased without any decrease in safety.

Another added feature is the combined hand and automatic-reset thermal overload relay. The automatic reset of this relay relieves the operator of the necessity of going to the starter to put the motor back on the line after an overload.

Champion Insulator Supports

A LINE of clamp insulator cable supports for either flat or pipe mounting by means of U bolts has been developed by the Champion Switch Company, Kenova, W. Va. The supporting bases are malleable iron and the top clamps are of alloy metal.

The white glaze porcelains are interchangeable and, according to the manufacturer, they were designed for in-

Champion Clamp Insulator Support

stallations of wide temperature variations such as exist in coke plants, foundries, and so on.

Greene, Tweed Packings for Acids, Alkalies and Petroleum Products

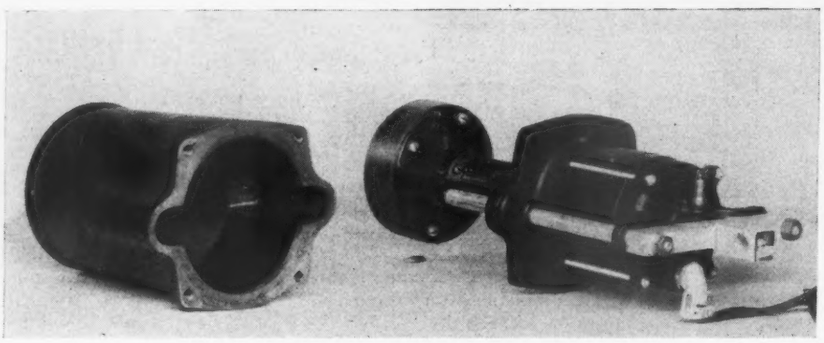
THREE kinds of packings, designated "Cutno," "Pelro" and "Palco," have been added to the line of packings brought out by Greene, Tweed & Company, 109 Duane St., New York City.

The Cutno packing is especially designed for use on pumps and other equipment where ammonia, caustic soda, hydrochloric acid, sodium carbonate and similar chemicals are handled. The Pelro is suitable for use with gasoline, naphtha, alcohol and similar liquids. The Palco line is intended for hydraulic pressures with hot or cold water and calcium brine.

Each form of packing is impregnated with a lubricant which resists the washing out tendency of the fluid pumped. The packings are available in braided form in sizes from ⅛ to 2 in. and in twists from 1/16 to ½ in.

G. E. Hydraulic Operator

THE Hydraulic Operator, an industrial control device has been developed by the General Electric Company, Schenectady, N. Y., to take the place of large a. c. or d. c. magnets and solenoids, and it may also be used to replace air cylinders where quiet and smooth upward thrust is desired through a given distance.



G. E. Hydraulic Operator

It consists of a motor-driven centrifugal oil pump, the impeller of which is mounted in a piston and driven by means of a spline shaft. This arrangement permits the stationary mounting of the motor. The normal position is with the piston at the bottom of the cylinder which is approximately two-thirds full of oil. When energized the motor drives the impeller creating a pressure between bottom of the piston and bottom of the cylinder.

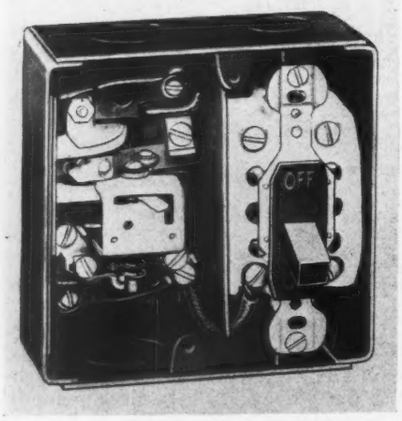
The piston is cast so that the oil is fed to the center of the impeller from both the top and bottom. The oil is forced from the end of the impeller blades through ports to the space below the piston. The pressure tends to move the piston upwards and it will travel the full length of the cylinder providing the load on the ends of the push rod is not too great.

The operators are rated on the stalled thrust basis; that is, the number of pounds they will balance when the motor is running at full speed. The three standard sizes give 200-, 300- and 600-lb. push. The speed of operating is slower than that of a solenoid, yet the movement is relatively fast.

The device can be applied to brakes, clutches, door and window openers, spot welders, pumps and other applications utilizing solenoids and air cylinders.

Allen-Bradley Overload Breaker

DESIGNED for use with motors driving small machines and auxiliary equipment such as pumps, compressors, fans, etc., the overload breaker illustrated, is being put out in six forms and in capacities up to 1½ hp. at 220 volts by the Allen-Bradley Company, 286 Greenfield Ave., Milwaukee, Wisconsin.



Allen-Bradley Breaker With Cover Removed.

The breaker is suitable for use with d.c. also single-phase and polyphase a.c. motors. It is designed for protection against burnouts and overload and may be obtained with or without snap switch and fuse clips.

"M.C.E." Centrifugal Babbitting Machines

CENTRIFUGAL babbitting machines in three sizes, 8-, 12-, and 18-in., have been developed and placed on the market by the Manufacturers' Consulting Engineers, 487 S. Salina St., Syracuse, N. Y. The capacities as listed above are for 8-, 12-, and 18-in. connecting rods, respectively.

The motor is built-in and is accessible through a large opening in the back of the base. Ball bearings are used on the spindle pulley and belt tension is maintained by a spring-type, roller-bearing idler pulley. A cone-type clutch drives the spindle, which is stopped by disengaging the clutch from the spindle pulley and engaging the other side of the clutch with a stationary brake drum. The spindle is mounted on ball bearings and carries the aluminum faceplate. Aluminum is used for this part to reduce starting and stopping loads. Air is run through the bearing being cast by means of a fan mounted on the back of the faceplate, and the time required to cool the bearing metal is thus reduced materially.

The clutch is thrown from the driving to the braking position by the vertical lever and the fixture clamp plate is opened or closed by the horizontal lever. Both levers stay in the position set.

Fixtures are generally made up of a wrist-pin stud and two die plates. One die plate has locating points for the crankshaft end of the rod and is mounted in the faceplate. The other die plate is mounted in the clamp plate. The connecting rod is clamped in place by three springs mounted on the clamp-plate guide rods. The approximate net weights of the 8-, 12-, and 18-in. sizes are 910, 970, and 1,140 lb., respectively. The floor space occupied is 30x30 in., 30x36 in., and 30x48 inches.

M.C.E. Centrifugal Babbitting Machine

"Weldite" No. 18 "Yellow Jacket" Electrode

A WELDING rod for arc-welding which will weld ⅜-in. unbeveled plates clear through with one passage of the electrode from one side is being manufactured by the Fusion Welding Corporation, 103rd St., and Torrence Ave., Chicago, Ill., a subsidiary of the Chicago Steel & Wire Company.

This electrode is especially manufactured for making heavy, mild-steel arc welds, and for that reason it is particularly adapted to plate welding in boilers, pipes and tanks.

The rod is used in welding plates, not beveled as in ordinary practice, but which are merely butted together.

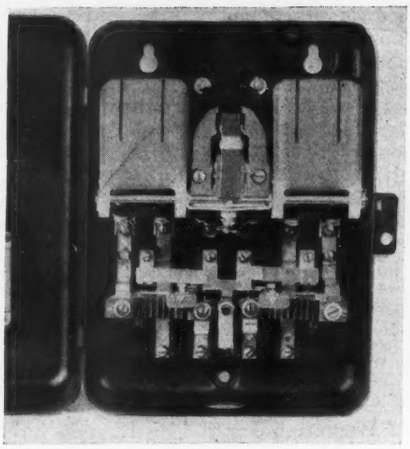
"Oxweld" No. 21 High-Strength Bronze Welding Rod

A HIGH-STRENGTH, bronze welding rod with a low melting point is being marketed by the Oxweld Acetylene Company, a unit of the Union Carbide & Carbon Corporation, 30 East 42nd St., New York, N. Y. The rod may be used for bronze-welding steel, bronze, brass, cast iron, malleable iron, wrought iron, copper, nickel, Monel metal, and similar metals, and for building up wearing surfaces and for fusion welding of bronze, brass, and other copper alloys. It is claimed to have a composition which does away to a great extent with the fumes given off in ordinary-bronze welding operations. The rod is obtainable in the standard sizes and in bundles of standard weight.

Sundh Across-the-Line Starter

AN across-the-line starter, called "6013 Aclinestor," with several new features and modifications is announced by the Sundh Electric Company, Newark, N. J. The switch has full-voltage automatic starter for remote control.

Among the outstanding features of the switch claimed by the manufacturer



Sundh "6013 Aclinestor" Across-the-Line Starter

are the following: Few moving parts; rugged construction; accessible Sundh magnet; no iron current-carrying parts; cadmium plated parts throughout; contacts instantly removable by the use of a screw-driver; coil removable by loosening two screws; switch and thermo relay on two different cold-molded bases; thermo overload reset from outside of box; switches complete in three and four poles; thermo overload adjustable for time interval; accessibility—coil contacts and thermo relay element instantly removable, etc.

According to the manufacturer, the switch has interrupted stalled rotor current far in excess of its greatest capacity. Start, stop and reset push buttons are straight through the box; there are no flexible leads.

Federal "Haydite" Precast Roof Slabs

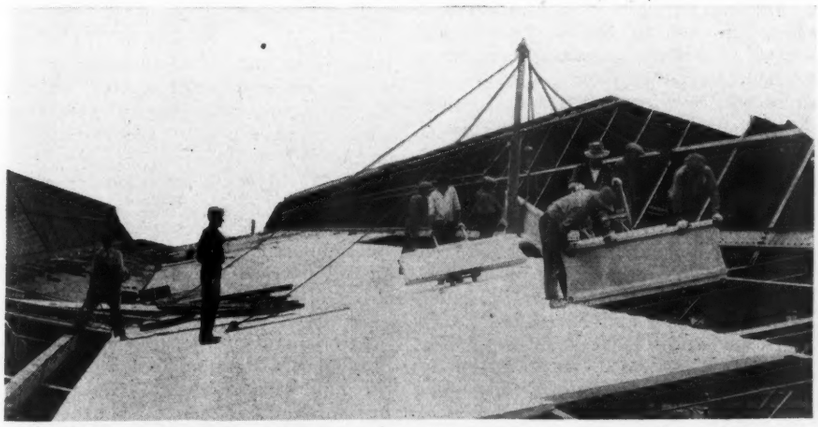
"HAYDITE" precast concrete slabs for roof decks have been placed on the market by the Federal Cement Tile Company, 608 S. Dearborn St., Chicago, Illinois.

The oxidization of the carbon content of shale when ground and burned in kilns at 2,000 deg. F. forms gases that cause the shale to expand into an inert, light-weight, cellular structure. This material, known as Haydite, is used as an aggregate instead of sand-gravel or stone in making these slabs.

It is claimed that two marked advantages result from the presence of the trapped air cells: *(1)* the concrete becomes very much lighter in weight than ordinary concrete, yet with the same structural strength, and *(2)* it possesses an insulating value heretofore unobtainable in concrete. One-third less weight is claimed for the Haydite slab.

Other advantages claimed are permanence, fire safety, absence of maintenance, saving in radiation and fuel in the design and operation of the heating plant, and that it requires no heavier steel design than any other material.

The slabs are precast in the form as shown in the accompanying illustration. For extreme conditions of heat and humidity it is possible to place a layer of additional insulating material over a Haydite concrete roof deck.



Showing how the light-weight, insulating concrete roof slabs are laid on the steel purlins.

Ohio Double-Reduction Speed Reducers

A LINE of double-reduction speed reducers to supplement its single-reduction line is being introduced by The Ohio Gear Company, 1333 East 179th St., Cleveland, Ohio. These speed reducers have hardened and ground worms, bronze worm wheels and are equipped throughout with Timken roller bearings. As with the single-reduction units, many different ratios are available, the high limit being 24,000 to 1. The illustration shows a case with the high-speed shaft horizontal and the low-speed shaft perpendicular. The case is also made with both shafts horizontal.

Ohio Double-Reduction Speed Reducer

The speed reducers are available in standard ratios of from 100 to 1 to 24,000 to 1 and in torque capacities varying from 100 to 3,200 inch-pounds.

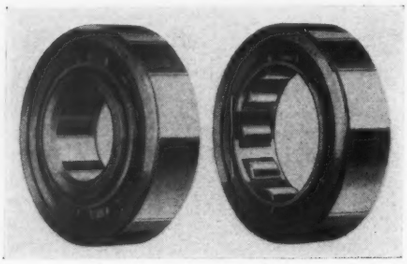
"Una" No. 65 High-Tensile Welding Rod

FOR flat, vertical and overhead manual welding and flat automatic welding, a high-tensile welding rod has been developed by the Una Welding and Bonding Company, Cleveland, Ohio. It is available in unit packages of 25 lb. in standard sizes varying from one-eighth to one-quarter inch in diameter and in 14-in. lengths and also in rolls for automatic arc-welding.

The rod is used for welding boilers, tanks, cast steel and structural work requiring high tensile strength and may also be used for building up wearing surfaces requiring machinability. A tensile strength of approximately 60,000 lb. per sq. in. is claimed for the rod. The rod is coated and is designed to permit gripping at any point and establishing an arc instantly.

Hyatt Single-Row Radial Bearings

TO satisfy the demand for a roller bearing interchangeable with standard S.A.E. single-row ball bearings, but having greater load capacity, the Hyatt Roller Bearing Company, Newark, N. J., is now manufacturing single-row radial bearings.



Hyatt Single-Row Radial Bearings

This line of bearings, made up of solid rollers, is not intended to replace the standard Hyatt roller bearing which uses spirally wound rollers, but is offered as a supplement to it, for positions in which space limitations exist, and where loads beyond the capacity of ball bearings must be sustained.

In the bearing the rollers are permanently retained with the outer race, the inner race being separable. A separator floating on the rollers spaces them properly, and heat-treated end rings retain them endwise within the outer race.

The manufacturer states that the single-row radial bearings are now in regular production in a range of sizes sufficient to cover the needs of the present for this type of bearing.

G. E. LS-438 Limit Switch

THE General Electric Company, Schenectady, N. Y., announces the development of a cam-operated limit switch for industrial control applications. This switch supersedes the various older types and combines all their advantages in one device.

It bears the designation LS-438, and is inclosed in a cast case. Electrically, it is a two-circuit switch which, by a simple adjustment, can be made either normally-open or normally-closed, or one circuit open and one closed. It is a snap-action, cam-operated device and can be obtained with either spring or star-wheel return with any one of four operating levers; a roller level with a 1-, or 3-in. roller, a forked lever or a straight lever. The contact tips are interchangeable with those of standard G. E. cam-operated master and geared limit switches.

G. E. LS-438 Limit Switch

American Askania "Kuppers Altimeter"

A SMALL device designed to adjust transmission and distribution lines to a definite amount of sag, and therefore to control the individual span is announced by the American Askania Corporation, Houston, Tex., under the trade name, "Kuppers Altimeter." The distinguishing feature of the apparatus is a parallelogram device coupled with a telescope that is free to swing in any direction.

The Kuppers Altimeter is erected at a convenient accessible point in the middle or outside the field of span. The plane of the parallelogram must be perpendicular to the plane of the span and fulfillment of this condition is insured by the familiar method of bringing down right angles. The sighting needle fitted to the instrument to facilitate rapid direction finding will then be parallel with the wire.

The measuring apparatus is set truly perpendicular by means of a circular spirit level. The telescope is then used to sight first one of the suspension wires, after which it is swung over to the second point. Using the fine adjustment screws, the two points are made to coincide on the cross-web; the telescope will then describe a straight line between the two suspension points. There is a graduated scale which at once shows the angle of inclination between the line connecting the two suspension points and the horizontal. By tilting the telescope, the connecting line is brought down exactly parallel; the operator having next ascertained by swinging to and fro that the plane of the line of sight is identical with a plane tangent to the overhead line. Only a minor calculation is then needed.

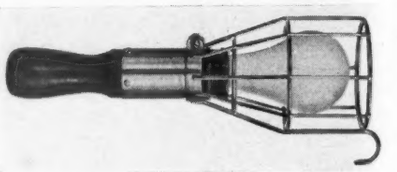
Line Material 2,300-Volt Box Fuse

A SMALL 2,300-volt, 30-amp. fuse has been brought out by the Line Material Company, South Milwaukee, Wis. The housing is of wet-process porcelain with a flashover value between terminals and hanger of 28,000 volts dry and 14,000 volts wet. The housing is provided with one petticoated lead entrance on each side. The box is provided with a galvanized-steel, adjustable, vertical hanger which fits all standard crossarms. A hanger can also be provided to mount this fuse at an angle if desired. Contact clips are double phosphor bronze to insure evenly distributed pressure on the cartridge contact blocks.

This fuse has an over-all width of 3 in. from the outside of the lead entrance on one side of the box to the outside of the lead entrance on the other side of the box. It is only 6 in. high. The maximum rating of this fuse is 2,300 volts, 30 amp. continuous carrying capacity. The company also makes this fuse with a different design of cartridge which is known as "arc chute expulsion" type.

Portable Lamp Guard

THE Economy Portable Lamp Guard has recently been placed on the market by the Electric Portable Company, 879 East Harrison St., Portland, Ore. The guard is made of steel wire, electrically-welded and, according to the manufacturer, provides ample protection for lamps up to 50-watt capacity.



The Electric Portable Lamp Guard

The guard admits standard, keyless, weather-proof sockets from 17/16 to 1½ in. in diameter and may be purchased either with or without socket. The guard also includes a wooden handle.

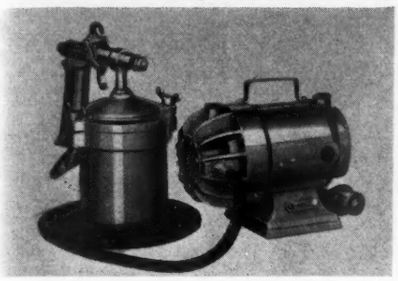
Houghton Absorbed Oils and "Cosmolubrics"

A COMPLETE line of Absorbed Oils and "Cosmolubrics" for plant lubrication is being introduced by E. F. Houghton & Company, Philadelphia, Pa. Several of the oils have been previously marketed, but until the present time, oils of all weights and for all uses have not been available. The absorbed oils are claimed by the manufacturer to consist of two oils in one, a film oil and a "lubricity" oil, the film oil acting as a piece of saturating blotting paper holding the lubricity oil on the bearings.

When the bearing is under slight pressure, a small amount of the lubricating oil is necessary and only a small amount is squeezed from the film oil. Under high pressure or when sharp or heavy loads occur, a greater quantity of this oil is necessary and a greater quantity is squeezed out of the film oil. When the load is decreased the film base re-absorbs the lubricating oil and retains it. The line of Cosmolubrics is complete from the very light to the extremely heavy-bodied oils.

Breuer "Tornado" Portable Electric Paint Sprayer

THE Breuer Electric Manufacturing Company, 852 Blackhawk St., Chicago, has placed on the market an electric paint spraying machine for



Breuer "Tornado" Portable Electric Paint Sprayer

touch-up work, shading, light finishing and refinishing jobs, as well as semi-production and maintenance work.

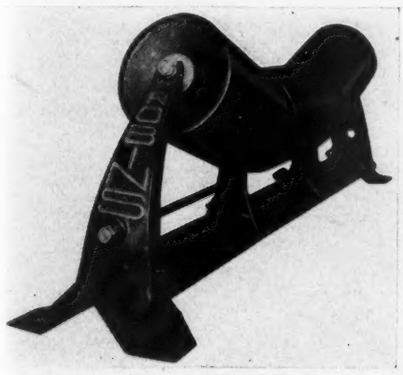
This equipment, known as the "Tornado" portable electric paint sprayer, is of the rotary compressor type, built of aluminum castings, equipped with 1/3-hp. G. E. universal motor, and develops a pressure of over 35 lb. The compressor unit weighs 7 pounds.

The gun is equipped with two tips, one slotted for fan spray and the other for narrow spray, thus covering an area of 2 in. to 14 in. An adjusting screw controls the amount of paint to be used. The gun weighs 2 pounds.

Robins Demountable Troughing Idler

THE Robins Idler, Style 203-YD, recently introduced by the Robins Conveying Belt Company, 15 Park Row, New York, is similar to the same company's 203-XR three-pulley Timken-bearing idler except that it has demountable pulleys.

The three pulleys with their bearings and grease seals are interchangeable. Each is of cast iron with totally-inclosed ends and may be lifted out without the use of tools by disconnecting one section of the grease line leading to the center pulley.



Robins Style 203-YD Demountable Troughing Idler

The side pulleys are set at an angle of 20 deg. from the horizontal. The gap between the pulleys is about ¼ in. The brackets between the pulleys and at the ends of the idlers are of malleable iron and are bolted to a structural-steel angle base.

Lubrication is obtained by means of grease forced through three high-pressure fittings. Each fitting supplies grease to a reservoir in the hub of one pulley and to the two bearings mounted in that hub.

Standard sizes range from 18 to 60 inches in diameter.

"Standard" Combination Grinder

THE Standard Electrical Tool Company, Cincinnati, Ohio, offers a combination grinder, having a ring wheel chuck on one end and an abrasive wheel on the other. The bearings are S.K.F. ball type. A ball thrust bearing is provided to take the end thrust of the wheel chuck.

The machine is made in 2, 3, 5, and 7½-hp. sizes.

"Production," "Buckeye" Motor

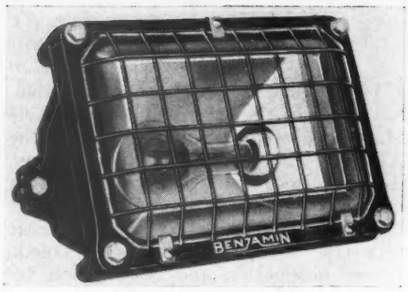
THE Production Equipment Company, Cleveland, Ohio, is providing its "Buckeye" buffing, polishing and grinding motors with welded pedestals in order to make a lighter, stronger job and render it easier to produce special heights and forms of pedestals when required. The motor itself can be furnished for any specified supply conditions, and is guaranteed for the unusual period of three years. All working parts are fully inclosed and the ball bearings are of grease-packed, dust-proof design.

Benjamin Pit Lighting Unit

A PIT lighting unit has been designed by the Benjamin Electric Manufacturing Company, Des Plaines, Ill., for built-in installation in those locations where space limitations or unusually severe service and atmospheric conditions make the use of ordinary types of overhead or side lighting equipment unsuitable. The heavy cast-iron body sets back in a recess in the masonry permitting full use of the working area.

According to the announcement, the pit lighting unit is impervious to water, gas or other corrosive elements. A heavy cast-iron body and cover frame houses the lamp and reflector. A brass wire guard protects the Pyrex heat-resisting glass cover from accidental breakage.

The lighting reflector is of porcelain enameled steel of a special trough shape design. It has a wide lateral distribution and accommodates either 100 or 150-watt lamps. Ample wiring space is arranged for the entrance of conductors, and provision is made for the easy removal and replacement of lamps.



Benjamin Pit Lighting Unit

Robbins & Myers Differential Chain Hoist

A DIFFERENTIAL chain hoist is announced by Robbins & Myers, Incorporated, Springfield, Ohio, in which tapered roller bearings are used in the lower hook.

The sheaves are of "Aremite," a metal made in the company's foundry, for which it claims unusual hardness and twice the tensile strength of ordinary gray iron.

Chains are of special analysis steel electrically welded. With the exception of the chains, aluminum finish is provided throughout.

The hoist is manufactured in five sizes with capacities ranging from ¼ to 2 tons.

Linde Acetylene Hand Torch

THE Line Air Products Company, 30 East 42nd St., New York City, has produced a hand torch using acetylene as a fuel. It consists of a standard 10-cu.ft, gas tank to which a burner and handle are attached. It is simple in construction and is adaptable to all kinds of soldering, splicing, wiping, and similar operations either inside or out of doors.

Linde Acetylene Hand Torch

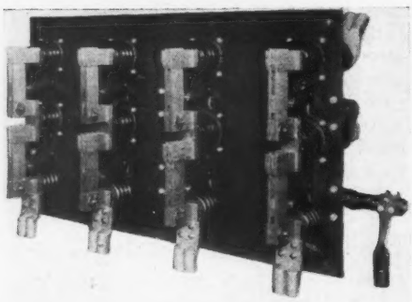
Air-Way Electric Appliance Unit Heaters

COINCIDENT with the announcement of the acquisition of the Erie Heating Systems, Inc., Erie, Pa., by the Air-Way Electric Appliance Company, Toledo, Ohio, is that of the marketing of the former Erie unit heaters as the "Air-Way Unit Heaters." The Erie industry has been moved to Toledo where production and distribution activities will be centered.

The Air-Way Unit Heater utilizes steam, hot water or vapor and can be used without change where such heating elements are already employed. It can also be used for cooling by means of brine, cold water, or any refrigerant. The heating unit is an integral casting of aluminum through which the air is driven by means of a motor-driven fan and, although light in weight the unit will withstand a pressure of 250 pounds.

Delta-Star Gang-Operated Disconnect Switches

THE Delta-Star Electric Company, 2400 Block Fulton St., Chicago, Ill., has developed a gang-operated selector switch, the blades in which are opened



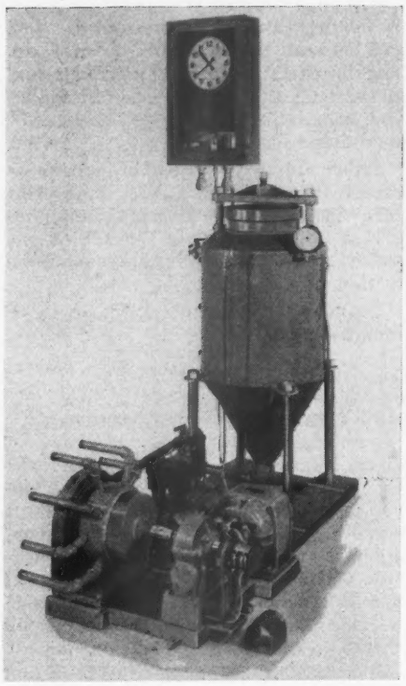
Delta-Star Gang-Operated Disconnect Switch

and closed simultaneously by means of an interlocked mechanism, the handle of which can be located at any convenient point.

Keystone Pneuma-Lectric Lubricating System

A FULLY-automatic, intermittent-feed lubricating system has been developed by the Keystone Lubricating Company, 21st, Clearfield and Lippincott Sts., Philadelphia, Pa. The system combines the Keystone pneumatic safety lubricator with a rotary distributor. A system of pipes delivers the lubricant from the distributor to the bearings.

Pressure is maintained on the system by means of a motor compressor unit with an automatic switch. The rotary distributor is motor driven through a reducer. Operation of the system is controlled by an electric clock which may be set to any pre-determined time period from five minutes to four hours depending on the requirements. A



Keystone Pneuma-Lectric Lubricating System

drum control switch prevents the distributor stopping on an open part.

The rotary distributors are made in two sizes, 2 in. and 8 in. Other sizes will be made to suit requirements.

Young Unit Heater in Recirculating Box

A HEATING unit suitable for both heating and ventilating service incorporated in a recirculating box designed for floor mounting is being marketed by the Young Radiator Company, Racine, Wisconsin.

This gives a flexible and convenient type of unit for a wide range of uses, as it can be placed in any location without further support. The heating sections consist of flat vertical copper tubes with brazed flat copper fins. The tubes are also brazed to the header plates. Thermostatic control can be provided when desired.

Hoover Single-Row, Annular Ball Bearings

DEEP-GROOVE, no-notch construction to withstand heavy thrust and radial loads at high speeds is a feature of the line of single-row annular ball bearings introduced in standard sizes by the Hoover Steel Ball Company, Ann Arbor, Mich. Both the raceway and the balls are made of high-carbon chrome-alloy steel, and the retainer is of riveted deep-drawing steel.

The bearings are available in three series: Light, medium, and heavy, ranging for the lighter series from 0.3937 to 4.7244 in. bore and for the heavy series from 0.6693 to 3.9370 in. bore.

Fairbanks, Morse Portable Trash Pumping Unit

A PORTABLE, trash-pump unit designed for the economical handling of fluids containing large solids and much foreign matter, particularly material of fibrous or stringy character such as is found in sewage has been developed by the Fairbanks, Morse Company, Chicago, Illinois.

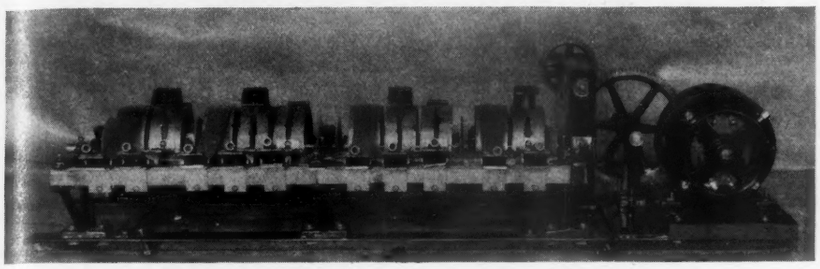
These pumps have two definite advantages which greatly influence the efficiency and economy of operation; first, continuity of performance without clogging; second, the elimination of the necessity and expense of screening out solid material in the fluids to be handled.

Several types of mountings are available; the platform, as shown in the accompanying illustration, for mounting on a truck body, a simple steel skid or a trailer truck with either steel or rubber tired wheels with or without spring suspension. The pump is designed to handle solid spheres as large in diameter as the pipe size next smaller than the suction connections.

Fairbanks, Morse Portable Trash Pumping Unit Mounted on Truck

Reynolds Industrial Control

A CONTROL device to regulate operations, the timing of which can be pre-determined, and known as RECO Industrial Control, has been announced by the Reynolds Electric Company, 2657 West Congress St., Chicago, Ill. The control consists of a motor-driven cylinder drum which is provided with adjustable contacts, making contact with a goose-neck brush as it rotates.



Reynolds "RECO" Industrial Control

The features set forth by the manufacturer are: Complete flexibility; any speed or timing desired; motor-driven and positive in timing; rugged construction throughout; all parts freely accessible; easy to understand, install, and adjust.

The control units are made specially to fit individual requirements.

Oster Pipe Threader

A PIPE threader, which incorporates, among other construction features, universal guides that automatically center the pipe, has been introduced by the Oster Manufacturing Company, Cleveland, Ohio. Other features of the tool, which is designated the "Leader" and which threads and cuts pipe from 1 to 2 in., are different ratchet construction, floating stud, and adjustable dies.

The threader is available in either of two types: No. 1, a plain tool without the ratchet device feature, and No. 1A, with the ratchet construction. It is claimed by the manufacturer that because the ratchet is built directly around the dies where the strain of the pull ordinarily comes, much less effort is required to cut the thread, and that this also permits more freedom of action when working close to a wall or in other cramped quarters. On the ratchet-type tool, the ratchet can be set for forward or reverse or can be locked for use as a plain tool, by a turn of a control wheel.

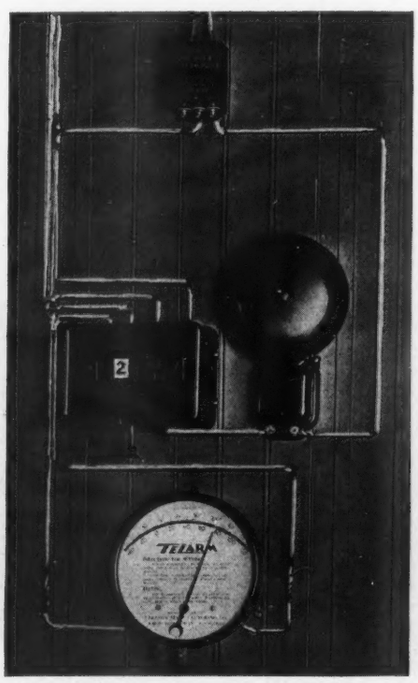
Lakeside "Telarm" Fire Alarm

A FIRE alarm system, known as "Telarm," which automatically transmits an alarm whenever the surrounding temperature goes above or below any pre-determined degree is being marketed by the Lakeside Manufacturing Company, 440 West Superior St., Chicago, Ill. The detector, shown at the bottom of the illustration, consists of a thermostatic element connected to an indicator hand which moves across a scale divided into degrees of temperature.

The indicator hand is electrically connected to one side of the power supply circuit. Incorporated in the detector are two movable contacts, which can be set on any degree of temperature, one on each side of the indicator hand. These contacts are electrically connected to each other and to the other side of the circuit.

When the contacts are set on the high and low temperatures limits, any change in the surrounding temperature will move the indicator hand and make contact, ringing a gong located in the circuit. Annunciators may also be used in addition to the gong. The alarm gong will operate on either alternating or direct current.

Lead-covered steel, brass, and solid silver contacts are used in the construction.



Lakeside "Telarm" Fire Alarm

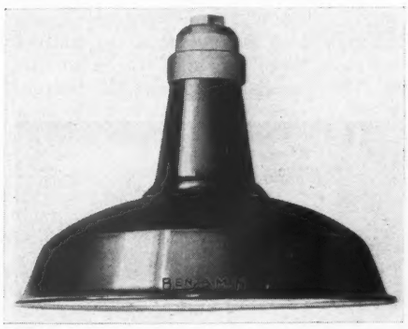
The system may be tested at any time by making contact between the movable contacts and the indicator hand.

Telarm may also be used for temperature control.

Benjamin Type "79" Dome Reflector

THE type "79" RLM dome reflector recently introduced by the Benjamin Electric Manufacturing Company, Des Plaines, Ill., is so constructed as to permit the reflector, together with the lamps, to be taken down with one movement for cleaning.

There are only two separable parts—the hood, which contains the wiring terminal base, and the removable reflector, with the lamp-holding element.



Benjamin Type "79" Dome Reflector

The three-point bayonet coupling locks the hood and reflector units together and at the same time completes the electrical connections. Contact is made at any point where the reflector enters the hood and polarization is automatically assured by the circular form of the electrical contacts.

The reflector conforms to the National Electrical Code standard.

Filecraft "Truarc" Flexible File

AN addition to the "Truarc" line, a flexible file which can be adjusted to any desired convexity of filing service has been introduced by Filecraft, Inc., 3450 Hamilton Ave., Cleveland, Ohio.

The complete file consist of two parts—the flexible reversible "blade" which carries teeth on both sides, and a bolt hole in each end; and the stiff "back" to which the blades are bolted. This back may be either supplied curved to the required degree or may be readily made by heating and bending one of the regular straight backs used for the regular Truarc backed files.

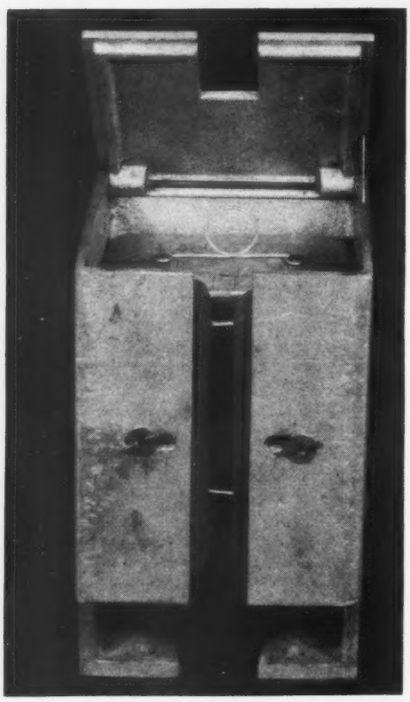
According to the announcement, the flexibility is obtained without any sacrifice of the sharpness and durability of the teeth; and files of this type are stated by the makers to be particularly useful in the automobile body, sheet metal and kindred industries.

Zenon Elevator Guide-Rail Lubricator

AN automatic guide-rail lubricator has been developed and placed on the market by Yvan Zenon, 244-22 136th Ave., Rosedale, L. I., N. Y. This device is designed to use a light grease as the rail lubricant and is mounted on the upper end of the top guide shoes on the car and counterweights. A light grease and graphite compound is recommended by the manufacturer of the lubricator for greasing the rails.

The grease is packed around the guide rails and is applied to them by the movement of the car and the counterweights. Each lubricator holds about two pounds of grease, which is sufficient to grease the rails for one year on an elevator as operated in the average office building.

The lubricator consists of an oil chamber designed to fit onto the guide rail and bring the lubricant in contact with the three working faces of the rail. There is a felt pad at the bottom



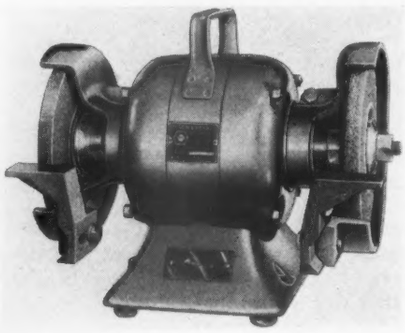
Zenon Guide-Rail Lubricator with Cover Raised

of the grease reservoir which acts as a packing to keep the grease in the reservoir and also to prevent an excess from getting on the guide rail. On top of the grease is a weighted pad to keep the grease in contact with the rail and to prevent too much grease being supplied when the lubricator is moving down. Two fiber shutters make a tight joint with the guide rail and completely close the reservoir on the rail. These shutters are held to the rail with springs that allow side motion of the guide shoes without interfering with the seal of the lubricator.

This lubricator supplies grease to the guide rails only when the car is in motion. The action is much as if the grease were applied by a soft brush rubbing on the surfaces of the rail. The device is adapted to either slow-speed or high-speed elevators, and it may be used on cars operating at speeds as high as 750 feet per minute.

Black and Decker Portable Bench Grinder

A 6-IN., ball-bearing, portable, electric bench grinder is announced by the Black & Decker Manufacturing Company, Towson, Md. This machine according to the manufacturer, is designed to meet the demand for a ball-bearing grinder within the price range



Black and Decker Portable Bench Grinder

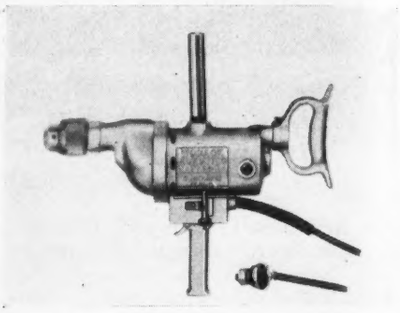
of the 6-in. and 8-in. sleeve bearing tools. It is for use on alternating current only, maintaining a 3,600-r.p.m. spindle speed on 60-cycle current and 3,000 r.p.m. on 50-cycle current.

Wodack Portable Electric Drill

A PORTABLE electric drill suitable for general drilling and for use with a bench stand is being marketed by the Wodack Electric Tool Corporation, 4627 West Huron St., Chicago.

The drill is equipped with a motor built for either direct or alternating current.

An oversize double-pole trigger switch is mounted in a convenient po-



Wodack Portable Electric Drill

sition on the drill as shown in the above illustration.

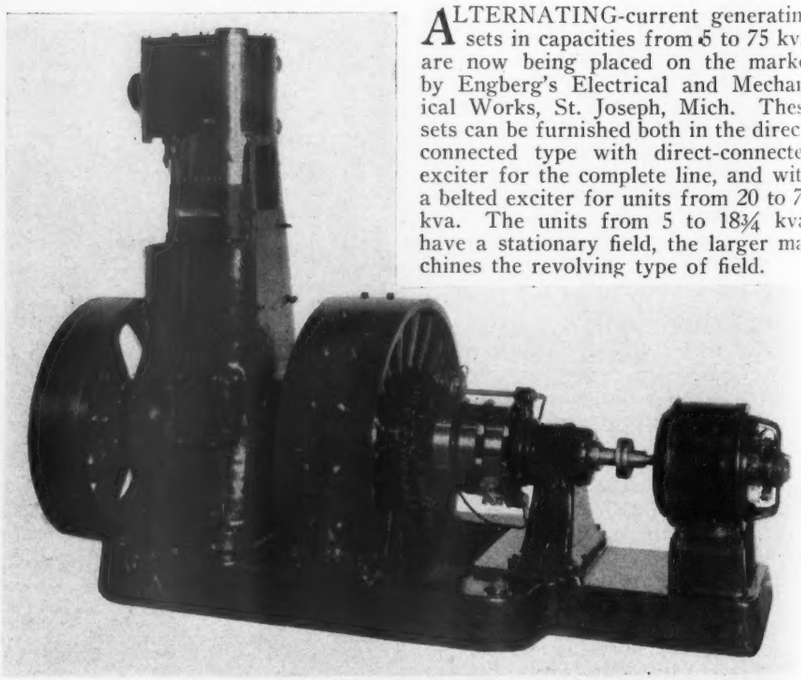
Anti-friction bearings are used, with the heavy thrust loads carried by roller bearings. Speed reduction between the motor and the drill is through hardened gears running in grease-filled casings.

Ventilation is obtained by means of an oversize fan for quick cooling during idle running.

The drill has a capacity up to 5/8 in. in steel and up to 2 in. in wood, depending on the material and on the depth required.

Engberg A.C. Generating Sets

ALTERNATING-current generating sets in capacities from 5 to 75 kva. are now being placed on the market by Engberg's Electrical and Mechanical Works, St. Joseph, Mich. These sets can be furnished both in the direct-connected type with direct-connected exciter for the complete line, and with a belted exciter for units from 20 to 75 kva. The units from 5 to 18¾ kva. have a stationary field, the larger machines the revolving type of field.

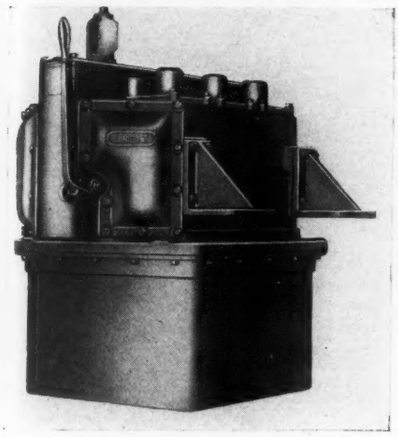


Engberg A.C. Generating Set

Condit Oil Circuit Breaker for Underground Service

IN the oil circuit breaker, designated Type M-210, for underground distribution service brought out by the Condit Electrical Manufacturing Corporation, Boston, Mass., a light, rapid-accelerating mechanism is used to give high-speed characteristics and easy operation.

The operating mechanism, bushings and current-carrying parts are supported by a heavy reinforced frame structure. Individual tanks per pole are provided of welded steel plate. space is provided in the upper part of the frame for two bushing-type current transformers per pole, in connection with which up to six trip coils can be furnished. Lead-covered cables enter at the top through sleeves with wiped joints terminating in a compound-filled pothead inside the breaker, from which porcelain insulators extend below the oil line. There are no exposed current-carrying parts above the oil line.



Condit Oil Circuit Breaker

The breaker illustrated is furnished manually-operated, three-pole, single-throw for 400 amp. at 15,000 volts, non-automatic or full automatic, with an estimated interrupting capacity of 60,000 kilovolt-amperes.

Pacific Electric Disconnecting Switch with Pry-Off Type Latch

A DISCONNECTING switch equipped with a pry-off latch, designated Type BB-1, has been announced by the Pacific Electric Manufacturing Corporation of San Francisco, Calif. The latch is of the pry-off type which, it is claimed, securely locks the switch in a closed position. When opening the switch the latch exerts additional leverage to break ice or sleet at the start of the opening stroke.

Insulators are of the standard, procelain-cemented cap and pin type. The contacts are of the tongue type with guides and blade contact ground in on a blade grinding machine.

TRADE LITERATURE

You Should Know About

Copies of literature which is described on this page can be obtained by writing to the manufacturer whose name and address are mentioned. It is always advisable to state the name and number of bulletin or catalog desired, as given in these columns.

(205) THE THERAPEUTICS OF ELECTRIC EQUIPMENT FOR STEEL MILLS"—This book by Dr. John S. Dean, maintenance engineer, is a very close analogy between the every-day ills of the human body and the troubles experienced in the maintenance of electric equipment for steel mills.—Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

(206) CENTRIFUGAL COMPRESSORS—A new catalog on centrifugal compressors and blowers has just been issued.—De Laval Steam Turbine Company, Trenton, N. J.

(207) CONNECTORS—Sumpter compression type connectors for wire connections are the subject of Bulletin No. 38-CC.—Delta-Star Electric Company, 2400 Block Fulton St., Chicago, Ill.

(208) ARC WELDING EQUIPMENT—Leaflet No. 20421 entitled "Multiple Operator Arc Welding Equipment" presents the application, distinctive features and general principles of construction of different types of stationary and portable multiple operator arc welding equipment.—Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

(209) ARC WELDERS—Folder G-14, improved "Stable Arc" welders, all types.—The Lincoln Electric Company, Cleveland, Ohio.

(210) ELECTRIC HEAT—Bulletin GEA-261A, application of electric heat to groups of basic operations commonly found in industrial plants.—General Electric Company, Schnectady, N. Y.

(211) PSYCHROMETERS—Catalog 2100, Bristol recording psychrometers, used to determine atmospheric moisture.—The Bristol Company, Waterbury, Conn.

(212) PANELBOARDS—Bulletin 48, safety-type flush and service switch panelboards, range switches, service switches.—Frank Adam Electric Company, St. Louis, Mo.

(213) POTENTIOMETERS—Bulletin 870, "Potentiometers for Temperature Control in Oil Refining," revised.—Leeds & Northrup Company, 4901 Stenton Ave., Philadelphia, Pa.

(214) WELDING RODS—Bulletin 3, "Type T Weldite Welding Rods."—Fusion Welding Corporation, 103rd St. and Torrence Ave., Chicago, Ill.

(215) MOTORS—Bulletin 6-1, squirrel cage induction polyphase motors, 2 and 3 phase.—Century Electric Company, 1806 Pine St., St. Louis, Mo.

(216) MOTOR GENERATOR SETS—Four page bulletin, motor generator sets, two- and four-bearing types.—Roth Brothers and Company, 1400 West Adams, Chicago, Ill.

(217) SAFETY—"Workmen's Safety Committees," Report No. 5 in the Industrial Safety Series. The leaflets in the series are based on studies of successful accident prevention work undertaken by modern industrial establishments.—Policy Holders Service Bureau, Metropolitan Life Insurance Company, 1 Madison Ave., New York City.

(218) CONDUIT—Supplement to fifth edition catalog, eight pages, Kondu Threadless Fittings.—Erie Malleable Iron Company, Kondu Division, Erie, Pa.

(219) MATERIAL HANDLING—"Rex 330 Catalog and Engineering Data Book," 800 pages. Chains, power transmission equipment, water screening equipment, and elevators and conveyors for the handling of material.—Chain Belt Company, Milwaukee, Wis.

(220) MAINTENANCE DATA BOOK—93 8½x11-in. pages of useful, well illustrated information dealing with exterior, interior, floor, roof and basement maintenance. Several pages of useful tables and specifications for the solution of a number of typical plant maintenance problems. Supply limited. Available only to engineers, master mechanics, plant superintendents, and others directly responsible for maintenance of plant and equipment.—The Truscon Laboratories, Detroit, Mich.

(221) DIESEL ENGINES—24 page catalog, vertical Diesel engines.—The Buckeye Machine Company, Lima, Ohio.

(222) LUBRICATION—Farval, the positive centralized system of lubrication for industry, illustrated.—Lubrication Devices, Inc., 61 South Washington St., Chicago, Ill.

(223) PIPE FITTINGS—Bulletin 79, standardized "Uniclamp" pipe fittings.—Delta-Star Electric Company, 2400 Block Fulton St., Chicago, Ill.

(224) TANKS AND TOWERS—Catalog, 40th annual edition, Caldwell tanks and towers of wood and steel.—W. E. Caldwell Company, Inc., Louisville, Ky.

(225) VALVES AND FITTINGS—Catalog 330, Pratt and Cady iron and bronze valves, asbestos packed cocks, and Reading cast steel valves and fittings.—Reading Steel Casting Company, Inc., Bridgeport, Conn.

(226) ARC WELDING EQUIPMENT—Leaflet 20421, "Multiple Operator Arc Welding Equipment." The application, distinctive features and general principles of construction of different types of stationary and portable multiple operator arc welding

sets.—Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

(227) ARC WELDER—Folder G9, four pages, "Electric Tornado" automatic arc welder, tractor type.—The Lincoln Electric Company, Cleveland, Ohio.

(228) DRYING SYSTEMS—Bulletin 100, "Dry-sys Induced Draft Heater" (Unit type).—Drying Systems, Inc., 1800 Foster Ave., Chicago, Ill.

(229) TEMPERATURE CONTROL—Bulletin 871-A, "Temperature Measurements in Generator Rotating Fields," No. 1-A in the Power Plant Series.—Leeds and Northrup Company, 4901 Stenton Ave., Philadelphia, Pa.

(230) STANDARDS—Commercial Standard CS 10-29 Brass Pipe Nipples. — Department of Commerce, Bureau of Standards, Washington, D. C.

(231) CAST IRON—Bulletin 207, "Properties and Applications of Nickel and Nickel-Chromium Cast Iron."—The International Nickel Company, Inc., 67 Wall St., New York City.

(232) AMMETERS—Bulletin 810, thermocouple ammeters and milli-ammeters for use on a.c. and d.c., and any frequency including radio frequency.—Roller-Smith Company, 233 Broadway, New York City.

(233) METERS—Addition to Bulletin 73, "Narrow Type HN Switchboard Meters, Alternating Current."—Sangamo Electric Company, Springfield, Ill.

(234) UNIT HEATERS—Bulletin 7818, Models, 1929, Venturifin unit heaters.—American Blower Corporation, 6000 Russell St., Detroit, Mich.

(235) DRILLS—Catalog, Aurora Drills, from 20 to 44 in. Also Oesterlein multiple drill head.—The Oesterlein Machine Company, 3301 Colerain Ave., Cincinnati, Ohio.

(236) PRODUCTION TEMPERING—Catalog 93, "The Homo Method for Production Tempering"—complete revision. — Leeds and Northrup Company, 4901 Stenton Ave., Philadelphia, Pa.

(237) FANS—Bulletin 10401. Forced draft fans, domestic.—American Blower Corporation, 6000 Russell St., Detroit, Mich.

(238) SWITCHBOARDS—Bulletin 47, "Fuslok" switchboards, dead front and safety type.—Frank Adam Electric Company, St. Louis, Mo.

(239) CABLE—Catalog, 12 pages, Condex Park Cable.—Simplex Wire and Cable Company, 201 Devonshire St., Boston, Mass.

(240) CHAIN—Ramsey Industrial Catalog 628, 85 pages of illustrations and data on power transmission with silent chain.—Ramsey Chain Company, Albany, N. Y.

(241) OUTDOOR SWITCHING EQUIPMENT—Bulletin-1003A, group-operated, tilting-insulator switches.—General Electric Company, Schenectady, N. Y.

(242) MOTORS—Catalog 29, "The Story of U. S. Motors."—U. S. Electrical Manufacturing Company, 200 East Slauson Ave., Los Angeles, Calif.

(243) PYROMETERS—Catalog 86, "Optical Pyrometers."—Leeds and Northrup Company, 4901 Stenton Ave., Philadelphia, Pa.

(244) OVENS—Bulletin 51, electric ovens for baking lacquer, japan and other finishes.—Despatch Oven Company, 622 Ninth St., Southeast, Minneapolis, Minn.

(245) GENERATOR UNITS — Leaflet L-20377, geared-turbine generator units.—Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

(246) ARMCO INGOT IRON—"HOW ARMCO Ingot Iron Saves in the Oil Industry."—The American Rolling Mill Company, Middletown, Ohio.

(247) ARC WELDING—Bulletin GEA-1125, describes the G. E. Arc welding school. — General Electric Company, Schenectady, N. Y.

(248) PYROMETERS—Catalog 87, "Potentiometer Pyrometers."—Leeds and Northrup Company, 4901 Stenton Ave., Philadelphia, Pa.

(249) ELECTRIC FURNACES — Catalog GEA-1146, Electric Furnaces for industrial use.—General Electric Company, Schenectady, N. Y.

(250) STARTER—Bulletin 20406, magnetic resistance type starter. — Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(251) OIL RECLAIMING—Bulletin 20287A, Sharples oil reclaiming process.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(252) STARTER—Bulletin 1661-D, magnetic starters.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(253) WELDER—Bulletin 20418, gas engine driven arc welding set.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(254) CIRCUIT BREAKERS—Bulletin C—1852, oil circuit breakers.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(255) SWITCHBOARD DEVICES—Bulletin GEA-940A, panel and benchboard pipe fittings. — General Electric Company, Schenectady, N. Y.

(256) HEATING DEVICES—Bulletin GEC 81A, soldering irons, glue and metal parts, heating elements.—General Electric Company, Schenectady, N. Y.

(257) WELDING DATA—Bulletin D.M.F. 5156, maintenance by the electric arc.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(258) METERS—Bulletin No. 78, ampere-hour meter.—Sangamo Electric Company, Springfield, Ill.

(259) CONNECTORS—Bulletin No. 38-CC, compression type connectors for wire connections.—Delta-Star Electric Company, 2400 Block, Fulton St., Chicago, Ill.

(260) BEDPLATES—Circular 1856, Westinghouse-Nuttall speed reducers.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(261) GENERATORS—Bulletin L 3746-E, synchronous motor generators.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(262) GENERATORS — Bulletin 20355A, engine-driven alternating current synchronous generators.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(263) LINESTARTERS—Bulletin S.P. 1842, line starters and linestarter motors.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(264) PANELBOARD — Circular D.M.F. 5150, "Nofuz" panelboards. — Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(265) MOTOR—Folder 5188, totally inclosed d.c. motor.—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

(266) PUMPS—Bulletin 150, useful information and miscellaneous tables.—Chicago Pump Company, 2300-2336 Wolfram St., Chicago, Ill.

(267) SWITCHES—Bulletin GEA-181A, a.c. inclosed, magnetic, motor switches.—General Electric Company, Schenectady, N. Y.

(268) CIRCUIT BREAKERS—Bulletin GEA-211A, for automatic and manual operation.—General Electric Company, Schenectady, N. Y.

(269) CLAMPS — Bulletin GEA-1095A, ground clamps for outdoor stations.—General Electric Company, Schenectady, N. Y.

(270) SWITCHBOARDS — Bulletin GEA-1128, vertical, self-contained, hinged panel, and benchboard.—General Electric Company, Schenectadv, N. Y.

Coming Events

The Associated Business Papers, Inc.—Fall Convention, Oct. 21 and 22, Blackstone Hotel, Chicago, Ill. Paul I. Aldrich, Chairman, Convention committee. The National Provisioner, Chicago.

Associated Industries of Massachusetts—Fourteenth Annual Meeting, Oct. 23 and 24, Copley Plaza and Westminster Hotels, Boston.

American Gear Manufacturers Association—The semi-annual meeting will be held Oct. 24, 25, and 26, Benjamin Franklin Hotel, Philadelphia, Pa. Secretary's office, 3608 Euclid Ave., Cleveland, Ohio.

International Acetylene Association—Annual convention, Congress Hotel, Chicago, Ill., Nov. 13, 14, and 15. Mr. L. F. Loutrel, president.

National Power Show—Eighth National Exposition of Power and Mechanical Engineering, Dec. 2-7, Grand Central Palace, New York City.

American Society of Refrigerating Engineers—Annual meeting to be held in New York City during week of Power Show. Time and location to be announced later.

American Society of Heating and Ventilating Engineers—35 annual meeting, Jan. 27 to 30, 1930; Hotel Benjamin Franklin, Philadelphia, Pa.

International Heating and Ventilating Exposition—To be held under the auspices of the American Society of Heating and Ventilating Engineers, Commercial Museum, Philadelphia, Jan. 27 to 31, 1930. Manager, Charles F. Roth, Grand Central Palace, New York.

Natonal Industrial Exposition—The first national industrial expositon will be held in the Hotel Stevens, Chicago, March 3 to 7, 1930. Management, Midwestern Engineering Exposition, 308 West Washington St., Chicago, Ill.